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THE KALEVALA.

By EDWARD CLODD.

CONCLUSION.

IN the middle of the twelfth century, Eric IX. of Sweden, incensed at the piratical inroads of the Finns, waged war against them, and effected, after a fashion, their conversion to Christianity. How superficial was the change is evidenced by the complaint of Pope Alexander III., that their pretence of conversion was commonly given up when it had served the purpose of saving them from danger. At the end of the fourteenth century "it would seem to have hardly reached more deeply than to the reception of baptism and of the priestly benediction in marriage."* And from that time till the present, although both Lutheran and Greek missionaries have penetrated to the remoter parts, the old animistic and shamanistic beliefs have survived, and are persistent wherever ignorance or half-knowledge abounds. In fact, the success of Christianity among the Finns, as among other races, was in proportion to the tact which was exercised in not violently uprooting the older faith, but in grafting it into the exotic. The same atmosphere of wonder and mystery played around both Christian and Pagan religion at their inception—the same needs created them, the same earth-derived juices nourished them; but varying conditions quickened the growth of the one and left the other in its rank and primitive wildness. And the wisdom of the Church was shown in recognising what was common to both, and in ennobling that which, however coarse and crude, was consecrated by the lapse of time in the faiths of races to whom her message came. Rome was content to retain Wäinämöinen and Ilmarinen by the side of St. Peter and other saints, so long as the people called themselves Christians and paid their tithes, and to her larger tolerance is due the preservation of much of the old runic lore which the ruthless zeal of the Lutheran priests would have destroyed.

Although a careful scrutiny may detect, notably in some of the invocations to the *Dii majores* of Finnish mythology, a loftiness of sentiment which is foreign to the unadulterated Kalevala, it is not till we reach the fiftieth rune that the Christian influence, still largely infused with native elements, and with wildest, and often, to modern ears, untranslatable details, is paramount. In this closing rune of the great epic, Marjatta is introduced as dwelling under her parent's roof in the innocence of a lovely maiden's life, "pure as the dew, holy as the stainless stars." So chaste in deed and thought was she that she would taste, touch, or handle no living thing which had not a virginal purity like her own. With the sheep which it was her duty to tend, she wandered over the grassy hill-slopes and through the woods, the birds singing above her, the golden cuckoo with silvery voice, welcomest of all, nor had she a care save to guard her flock and herself from the venomous reptiles that crept under the trees and glided along the grass. One day, as she was listening to the cuckoo's song, a red bilberry lifted its voice and invited her to pluck it, telling her how many maidens had in vain sought to do so. She could not reach it, but knocked it down with a stick, when it fell to the ground, and at her bidding climbed from her feet to her lap and from her lap to her lips. She swallowed it, and it began to germinate.* Stealing home to her bath-chamber, after the custom of Finnish women,† with her robe in loose folds about her, her movements gave her mother disquiet; but she could not find out the cause, although the child spoke from within.‡ When the birth-hour drew near, Marjatta asked her mother to give her shelter, but was met with reproaches and shameful words. Defending herself in vain, she turned to her father, who likewise spurned her, and called her foul names, when she indignantly asserted her purity, and boasted that she would give to the world a hero before whom the heroes of her country would quail—yea, before whom even Wäinämöinen himself would be humbled.

Then she sent her little maid to one Ruotus of Sariola, to beg for a bath, and as the girl went thither all nature travailed; rocks, forest-trees, hill-slopes, quicksands, all vibrated, as it were, in sympathy. But the wife of Ruotus bade the girl tell Marjatta to go to the top of Kyto's mountain, and there lie down in a stable among the beasts, and let the cattle bathe her with the warm vapour of their breath. Then Marjatta repaired to a stable on the hill of Tapio, the forest-god, and with tears and prayers besought the Creator, of his rich mercy and grace, to deliver her, and asked succour of the animals around her. Then their breath came upon her as a hot bath, as holy water, and the child was born—brought forth in a stable and cradled in a manger. But as she fondled him, her "dear golden apple, her little silver staff," suddenly he disappeared; nor could the poor distracted mother, searching for him far and near, find his whereabouts § She prayed to star and moon to tell her where he had gone, but neither knew, each replying that their duty was only to brighten the night. She asked the sun, and

> Wisely then the sun made answer:
> Well I know thy child beloved;
> It was he alone who made me,
> Lets me rush in gold through heaven,
> Lets me beam in silver splendour
> All the lovely days of summer.
> Yea, I saw thy son beloved,
> Him, thy babe, oh thou unhappy.
> There he stands, thy son so little,
> In the marsh up to his girdle
> To his arms within the heather.

* Robertson's *History of the Christian Church*, VII., 418.

* Cf. Mexican legend, in curious correspondence to the above, quoted from Bancroft's *Native, Races* III., pp. 288-9, in Nadaillac's *Prehistoric America*, p. 297.

† *Vide* "Le Duc," p. 222, Note 1. ‡ Luke i. 44. § Luke ii., 43-45.

There Marjatta found him and carried him home. But as yet he had no name, only the pet names which mothers all the world over give to their babes, and the opprobrious name of base-born idler, which the neighbours cast at him. So Marjatta took him to Wirokannas, "god of oats," to be baptised, but he refused unless Wäinämöinen gave consent. When the old Runaio was consulted he said that so strangely-begotten a child should have no baptism, but be knocked on the head and buried. The child, then only two weeks old, rebuked the "old and steadfast," for his crass stupidity, folly, injustice, and crime, whereupon, with such proof of his supernatural power, Wirokannas hesitated no longer, but baptised him, gave him a royal name, and sole kingship over Karelia.

Filled with despair and rage, and crushed in spirit, Wäinämöinen fled to the seashore, and sung his Jeremiad. By the magic of his song he built a magic ship, then taking helm in hand, was borne tideward to the farthest marge that fringes the undiscovered land, singing as he went: "Times go by, and suns shall rise and set, and then shall men have need of me, and shall look for the promise of my coming, that I may make a new Sampo, and a new harp, and bring back sunlight and moonshine, and the joy that is banished from the world."* Reaching the lower spaces of the sky:

> There his galley gained the haven;
> There abode the ship and hero;
> But he left his harp behind him;
> Left his music sweet in Suomi,
> For the people's joy eternal—
> Noble songs for sons of Finland.

With this, a brief epilogue excepted, ends the Kalevala. In the foregoing analysis but scant space has been given to the question of the source of incidents of which correspondences exist in the epics of other races. The lyric songs interspersed amongst the runes, forming a rich and independent literature, are indigenous to Finland, and perhaps to Esthonia. They are the wood-notes wild of a people whose life is pitched in a mournful key; under whose ungenial sky and amidst whose melancholy forests and waters there could arise no song of gladness, such as the groves and valleys of more favoured lands, the smiling banks of the Pênêus, the plains of Olympia, inspired; nor cheerful, happy gods and nymphs of river, tree, and meadow be created. Finnish song says of itself that its

> Harp is made of sorrow only,
> Built up only out of sadness,
> Of the clouded day its framework,
> Of distress its chords are fashioned.

But in the epic portions the influence of the myths and legends of other peoples may be traced. That those of the Esthonians and Finns would correspond is to be expected in view of the common origin of both races, and it may be that more primitive forms of the Kalevala and the Kalevipöeg exist among the half-savage Ugrian tribes, to whom those peoples are more or less related. Some ethnologists have identified the Finns with the Accads, or primitive non-Semitic Babylonians, from whom the Semitic culture appears to have been derived, whereas their true home is the Altai region. And M. Lenormant maintains that the Accadian triad of deities, Ana, Hea, and Muh-ger, corresponds to the Finnish triad, Ukko, Wäinämöinen, and Ilmarinen. But Ukko forms no part of such triad, the place given to him by M. Lenormant being filled by Lemminkäinen. If we are to find any parallels of these three heroes, they must be looked for in the Scandinavian Odin, Thor, and Loki, or Baldr. Perchance certain characteristics of the one group of demi-gods have been adopted by the other, as, *e.g.*, the harsher physical features of Wäinämöinen may have been softened by the moral qualities of Odin. The pre-eminence of Odin lies in his wisdom, his lordship over nature, his invention of the art of poetry, all which has its counterpart in Wäinämöinen. Thor, the god of lightning and thunder, always armed with hammer, corresponds to Ilmarinen, "the everlasting hammerer." Passing by further similarities in the respective heroes, there is in the Sampo (the resemblance of which to the quern of Norse myth has been already pointed out) a curious correspondence to the magic fetter called Gleipnir, made by the dwarfs at the command of the Al-Father to bind the wolf Fenrir. "It was fashioned out of six things—to wit, the noise made by the footfall of a cat, the beards of women, the roots of stones, the sinews of bears, the breath of fish, and the spittle of birds."*

The Scandinavian constituents in the Kalevala are, however, not numerous; the correspondence between its gods and those of the Egyptian, as Osiris, Typhon, Isis, and Horus, are due only to the personified natural phenomena which lie at the base of each, and not to historical intercourse through the Greeks or otherwise, as some critics contend; and the origin of this Iliad of the North must be referred to that mythopœic stage in the history of the Finns, or of their ancestors, when the operations of nature and the deeds of heroes became blended into one tradition which inspired the immortal songs whose burden is the passion and prowess of man.

* In Esthonian myth, Kalevipöeg vanished, and was nailed to the gates of hell.

OUR HOUSEHOLD INSECTS.

By E. A. Butler.

COLEOPTERA (*continued*).

ALL the insects hitherto enumerated belong to the family *Ptinidæ*, of which they constitute one section, the *Anobiides*, distinguished, at least so far as our house-feeders are concerned, by their more cylindrical form, compact make, and shorter legs. In the other section, the *Ptinides*, to which we now turn our attention, the shape is more globose, the antennæ and legs much longer, and the thighs so much thickened at the outer extremities as to become club-like. From their shape it would be easy to conjecture what would be in accordance with facts, that they have less to do with cylindrical burrows than their companions who "swear by" Anobium.

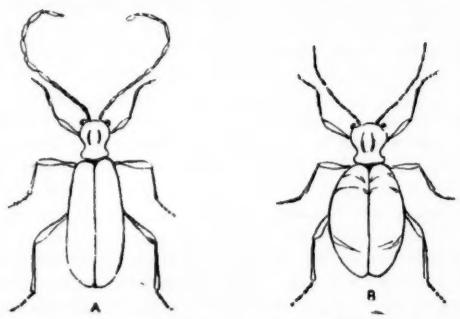


Fig. 1.—Ptinus fur. A, male; B, female.

The typical genus of the Ptinides is *Ptinus*, and the commonest species of that genus *P. fur* (Fig. 1). This is also a household insect, and is of somewhat varied habits.

* Mallet's *Nthn. Antiq.*, p. 424.

It well exemplifies a peculiarity exhibited with more or less distinctness in several species of this genus, viz., dissimilarity in shape between the sexes; the body of the male is almost cylindrical, but that of the female inflated or rounded at the sides, a feature which so alters her appearance that a novice would be certain to divorce her from her husband and consider her a distinct species. It is a reddish brown, hard insect, with two narrow and somewhat indistinct bands of white hairs on the elytra; the head is so much bent under the thorax that it cannot be seen from above, so that the insect appears as though it had been decapitated. The legs are long and straggling, notwithstanding which the creature is slow and heavy in its movements. The thorax is a good deal contracted behind, appearing as though it had been tied round tight while soft, and had hardened in that condition. By attending to these few points of distinction, there can scarcely be much difficulty in recognising a *Ptinus*.

This insect is a great foe to natural history collections, whether of animals or plants; and if by any chance it can manage to effect a surreptitious entrance into such, it does its best to execute the sentence "dust to dust" upon them. But its tastes are varied, and range from such excellent diet as the precious grain stored in granaries to the apparently less attractive nutriment furnished by the threadbare fabric of an old coat, the vegetable and the animal diet seeming equally suited to its taste, though it was at one time considered to be so largely an animal feeder as to have been called by De Geer "*vrillette carnassière*," the carnivorous borer.

Those who keep collections of foreign insects may sometimes have the privilege (?) of breeding (unintentionally) exotic species of *Ptinus*. Dried insects, when arriving from abroad, sometimes contain in their carcases living larvæ of *Ptinidæ*, which fare sumptuously, though silently and unobserved, upon the "dried meat" by which they are surrounded—a veritable "life in death." I remember on one occasion looking at a store box of exotic insects that had not been opened for some time, and being astonished at finding a colony of some dozen or so of a beautiful bright red *Ptinus*, prettily ornamented with snow-white spots, gaily disporting themselves amongst my stores, quite regardless of such insecticides as were present. I succeeded in tracing them to the huge carcase of a gigantic beetle that I had unfortunately introduced into the society without previously submitting to quarantine, and in whose interior the larvæ had evidently been holding carnival at the time of his introduction. The *Ptini* turned out to be a Polynesian species, which had thus completed their life cycle many thousands of miles from their birth-place. On their exclusion from their coleopterous host, they seemed to have decided on a change of diet, and so had calmly attacked the cork lining of the box, neatly excavating in it a series of hollows, to the extreme detriment of its appearance, at least from my point of view.

A most extraordinary trio of beetles now calls for notice. They are closely allied to the genus *Ptinus*, and belong to the same section of the family. They have very much the appearance of spiders, for which, indeed, they are often mistaken. The first is *Niptus hololeucus* (Fig. 2). It is a small beetle, completely covered with a yellowish silky down, and its resemblance to a spider is produced by three peculiarities. A spider (which, be it remembered, is not an insect at all, but a member of the class Arachnida) has only two apparent divisions to its body, the hindermost of which is usually highly convex and rounded at the sides, and it has also eight legs. Now, though *Niptus* has distinctly the usual *three* divisions of an insect's body—head, thorax, and abdomen—the first of these is so bent under the second that, as in *Ptinus*, it cannot be seen from above; and, in consequence, the body seems, like that of a spider, to be composed of only two parts. The elytra are very convex above, and much inflated and rounded at the sides, and as the line of their junction is completely obliterated, the abdomen acquires the globose and undivided form of that of a spider. Again, the antennæ, which are about equal in length to the legs, and, of course, on account of the bending of the head, appear to come from underneath as much as the legs themselves do, make up, with the usual six legs, a number of appendages that may readily be taken for the eight legs of a spider. The imitation is so complete, that, when only casually seen, the beetle might easily deceive even those who are perfectly familiar with the differences between an insect and a spider. When once one examines it closely, however, the apparent resemblances vanish, and the creature is easily seen to be a true insect, and is moreover found to be as hard bodied as a *Ptinus*, instead of exhibiting the soft and yielding integument of a spider.

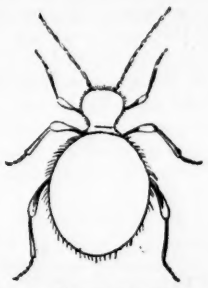


Fig. 2.—Niptus hololeucus.

Fig. 3.—Scales of Niptus.

It occurs commonly in houses, often in considerable numbers. It is not a wood-borer, but feeds on anything it can come across that is at all edible, and, in consequence, most frequents cupboards where stores of provisions are kept. It was once found in great numbers in a plate cupboard, where it was *said*, though with what degree of justice it is very difficult to understand, to have done considerable damage to the silver stored there. It has no wings, and is therefore not much of a wanderer, so that when a colony has once established itself in any part of a house, the successive generations are likely to remain in those quarters as long as provisions last, unless forcibly ejected. It is probably not a truly indigenous insect, but, like many others, has been imported from abroad, so that although not blessed with great powers of locomotion, it has yet been a considerable traveller.

Under the microscope the yellow clothing of *Niptus* is seen to be composed of two totally distinct elements. There are a number of longitudinal rows of long hairs or bristles, projecting considerably above the general surface and pointing backwards; and beneath these, closely covering the body, a quantity of tiny yellow scales overlapping one another. Each scale (Fig. 3) is bluntly pointed at the place of its attachment to the body, and at the outer extremity is usually produced into two long pointed projections at the sides with a shorter one between them. Not unfrequently the central process is also cleft. When the scales are removed the body beneath is seen to be highly polished and of a deep chestnut colour.

(*To be continued*).

MESSRS. C. ISLER & CO., of Southwark-street, have secured the contract for supplying their patent registering turnstiles to the International Inventions Exhibition.

METEORS AND FALLING STARS.

By Richard A. Proctor.

(*Continued from p.* 318.)

As to the real change of the velocity or direction of motion which our earth can impart to a meteorite approaching her from interplanetary space, it will be seen from the discussion of the mathematics of meteoric motion which is running on *pari passu* with these more popular papers that it may be altogether neglected in comparison with the apparent change due to the earth's rotation. This last only need be considered, and as this must be slight, we see that regarding observed meteors as bodies moving around the sun in orbits of considerable extent, intersecting the orbit of the earth, the constant position of the radiant point on the starsphere, even while the rotational direction changes through a whole right angle can be understood. Moreover the observed fact in this case can only be explained by attributing to meteors the rapid motions corresponding to such orbits. I may note, however, in passing that a change of radiant by more than a degree ought in several cases to take place as the earth's rotation changes the direction of the observer's motion; and the circumstance that no such change of radiant has been detected, though it must undoubtedly take place in the case of some meteor systems whose components move in known orbits, and therefore with known velocity, must be remembered later when we are inquiring into the significance of Mr. Denning's discovery.

The discovery that meteors travel around the sun, led to the recognition of their true orbits in several instances. With this part of the subject of meteoric astronomy I will not at present deal, because I have dealt with it very fully elsewhere. Suffice it to note that it led to the discovery that some meteor systems travel in the orbits of known comets, and to the belief that every meteor system is associated with some comet, known or unknown, existing now, or long since dissipated (as Biela's comet was recently dissipated) by solar action or other disturbing forces.

Schiaparelli, to whom this special result was mainly due, though the hardest part of the work of research was done by Prof. J. C. Adams, was led to a speculation respecting the origin of meteors and comets—viz., that meteor systems or comets are groups of discrete bodies drawn from out the interstellar regions towards our own system, and then compelled by planetary perturbations to travel (sometimes) on cloud paths round the sun.

Since some certainly among the meteor-systems have periods of moderate length, this theory of Schiaparelli's would regard the short-period comets or meteor-systems as drawn out of the interstellar depths, while manifestly it would be absurd not to extend Schiaparelli's theory comets or meteor-systems travelling on non-re-entering paths. In fact, he himself regards his theory as requiring the occasional appearance of meteors of hyperbolic path, and therefore as not merely consistent with the phenomena of hyperbolic comets, but accounting for them. Adopting his theory, then, to its fullest extent, we should regard all comets and meteors as bodies coming from the interstellar depths; for it is not easy to see how any comet or meteor-system could be so far distinguished from its fellows as to be regarded as originally a member of the solar system.

But for reasons which appear to me incontrovertible, I find it impossible to give in my adhesion to Schiaparelli's views, in the form in which he has presented them. A line ought to be carefully drawn between what has been proved and what has not been proved respecting the opinions which Schiaparelli has advanced. His most happy conception, that meteors would be found to travel in the paths of comets, has been realised, and no possible question can be raised as to the completeness of the demonstration; but it is quite otherwise with his supposition respecting the *manner* in which meteoric systems or comets have been introduced into the solar system. It not only has not been proved that comets have been compelled by the perturbations of the planets to become permanent members of the solar system, but it has practically been proved impossible that such an event should occur.

(*To be continued.*)

THE WORKSHOP AT HOME.

By a Working Man.

Nearly all the cheaper furniture that is sold is not made of the wood which apparently forms its material. It is really nothing but deal or beechwood, "veneered." A veneer, I must explain, is a thin sheet of some valuable wood, as thin as a sheet of paper. Those most commonly in use are cut from mahogany, rosewood, and walnutwood, and less frequently from bird's-eye maple, and are laid over the finished piece of work in the manner I propose now to describe. Only soft woods can be properly veneered upon, and the amateur is particularly requested to notice that he cannot veneer over a knot. The tools required are sufficiently simple if the surfaces to be veneered are flat. The workman will want, first, a toothing-plane. This is something like Fig. 5, Vol. VI., p. 154, only the iron is very nearly upright, and is fluted with very narrow grooves along its whole width. What this does is really to scratch the wood and veneer, and give them what workmen call a "tooth," to make the glue hold better. A wood file or rasp and a glue-pot we have already, and our remaining needs are a veneering hammer, a sponge, and basin of boiling water, and a laundress's flat-iron. There are two or three forms of veneering-hammer. The massive one used by the professional cabinet-maker is not so easy to work with as the form shown in Fig. 43, in which A represents a side, and B a front, view of the

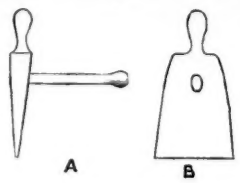


Fig. 43.

hammer. I shall describe the mode of using it immediately.

Now, the first thing to do is to take the saw-marks out which will probably be visible upon our sheet of veneer when we buy it at the wood-yard. This is done by a fine toothing-plane. If, as is far from unlikely, the beginner should split the veneer, he may mend it by glueing a piece of brown paper on to what is to be the upper (or out) side of it. In cutting it out, it should rather overlap the surface to be covered. If, which also is likely enough, it should be cockled, it may be damped and left in a screw-press for twelve hours—or, what is the same thing, laid on a flat floor with a board and some heavy weights on the top of it. Sharp scissors, or a penknife guided by a straight-edge, will generally cut veneers to the required shape.

Very well, then; we begin by roughening the surface to be veneered with the toothing-plane or with a rasp; and, this done, we provide ourselves, as I have said above, with a glue-pot full of freshly-made, thin, boiling glue, a basin of boiling water, a sponge, a hot flat-iron, and a duster. We begin by warming the surface to be veneered by ironing it, and, meanwhile, put our veneering-hammer into the boiling water. Now damp the side of the veneer which is to form the surface of the finished article with boiling water, and rapidly glue the other side and also the face upon which the veneer is to be laid. This done, the two glued surfaces must be brought together as rapidly as possible, and the thin sheet of ornamental wood rapidly pressed down with the hands; immediately upon which the hammer is to be taken out of the boiling water, wiped rapidly with the duster, and (being held close to the pane, with the handle turned from the operator) passed heavily and rapidly about, with a wriggling movement, from the centre of the surface to the edges, so as to squeeze the glue out. If this is dexterously done with a moderate-sized box, such as a writing-desk or violin case, the whole operation should be successfully performed before the glue sets; but, with a big job, some places may be missed, and the veneer not touch the wood underneath, or rise in a blister. We shall want our hot iron to re-liquefy the glue in this case, and then we must go over the sore place or places again with the hammer. N.B.—The hammer should always be kept in the basin of boiling water until the instant it is wanted. Finally, when you have satisfied yourself that the veneer and the wood beneath it are everywhere in intimate contact, sponge the whole veneer over with the sponge, just *damped* in the hot water, and dry it with the duster.

The process I have tried to describe is not a very difficult one, but when we come to deal with curved surfaces, veneering becomes a rather more complicated job, as we quite evidently cannot use the hammer to bring the two surfaces close together. In such cases we have to use what are known as "cauls," which are the exact reverse of the surface to be veneered, just as in an embossing press there is a convex counterpart of the concave disc. A good many of these are made of zinc, some of pine, and occasionally (in making telescope tubes of veneer, for example) canvas cauls are used. In the case of the zinc and wood cauls, of course a fresh one is required for every new surface. The wooden ones are sodden with linseed oil to retain the heat and prevent the glue from sticking to the caul. Obviously the pine cauls cannot be heated to the extent that the zinc ones can, and they are proportionately less effective. This is not the place to enter into the contrivances used in large workshops for obtaining pressure. String and bed-ticking will suggest themselves as useful material to bind round the caul and the veneer in the case of the amateur. Veneering elaborately curved work, however, is a job scarcely to be attempted in a Workshop at Home.

There is a very effective method of decorating cabinet-work with veneers which may just be touched on here. In its highest development it is called Buhl or Reisner work, but inlaying is quite fine enough a name for it for our purpose. It is executed in light and dark woods. Suppose, for example, that we have two veneers—one of ebony, and the other of holly. We glue them together with a sheet of very thin paper between them. This is to enable them to be more easily separated. Then upon the uppermost one we draw a pattern—say, of the conventional honeysuckle. Now, with a very sharp penknife we carefully follow the outline of this, cutting right through both veneers. It is easy so see that the piece removed from the black ebony will fit with absolute exactness into the opening in the white holly, and that the piece of white holly will in turn accurately fit the hole in the ebony. The pieces are separated by splitting the paper, and the black honeysuckle on a white ground, and the white honeysuckle on a black ground, glued on to the article to be ornamented.

In order to finish our veneered box, or other piece of work, it only remains to French polish it. French polish is nothing but shellac dissolved in spirits of wine (methylated spirit being all but invariably used). Makers add various ingredients, but not one of them is essential, and the amateur can make it for himself by putting a little shellac at the bottom of a bottle, filling the bottle up with methylated spirit, and shaking it from time to time until the lac has all dissolved; in fact, making very thin (so-called) "liquid glue." It, however, is not very expensive to buy if he does not care for the trouble. I will suppose that he has obtained it in one of these ways, and wishes to polish a veneered tea-caddy. The first thing is to true up all edges of the veneer that in any way show, the next to sand-paper the article carefully over. After this mutton-suet may be rubbed into the pores of the veneer, which may be again sand-papered and then well rubbed with linseed-oil by means of a saturated ball of cotton-wool. Care must be taken, though, to remove all superfluous oil afterwards. This done, we saturate another piece of cotton wool with polish and float the whole surface with it. It is then set aside that this may dry in and harden. When this has taken place, we once more go over the surface with very fine glass-paper, and then begin our polishing proper. The best rubber that I know for that purpose is made of what is called "list," torn off the edge of flannel. It is wound spirally to a diameter of a couple of inches or so, and tied tightly round with string. This is well wetted with the polish, wrapped up in and tied into a piece of linen rag, and then a drop or two of linseed oil is placed on the rag, and the polishing begun with a series of circular strokes kept evenly up, very little pressure being used. Particular care must be taken never to let the rubber remain stationary, and never to *lift* it straight up off the work. Having in this way got up a sufficiently brilliant surface, the work is set aside for an hour or two for the polish to harden, when it is once more rubbed down with the finest glass-paper, and the process of polishing repeated, and so on. Finally, the surface is gone over with a new cotton-wool rubber moistened with a few drops of spirit, and the final strokes are given horizontally instead of circularly. French-polishing should always be performed in a hot room. The atmosphere of those in which the beautiful Tunbridge ware is polished is quite stifling.

THE EVOLUTION OF THE SENSE OF BEAUTY.

By CONSTANCE C. W. NADEN.

(*Continued from page* 368.)

FROM pleasure in *colour* I pass to pleasure in *form*, which seems at first sight scarcely explicable on our theory. However, let us take heart of grace, and inquire into the matter.

Except that there is no actual contact, form exercises the eye much as it exercises the hand. The baby enjoys feeling shapes as it enjoys seeing shapes; and for a long time it wants to handle everything that it can see. But, growing older, it learns that many things can be seen which cannot be handled; that very often it "can't reach,'

and very often, too, it "mustn't touch;" that, besides, it can look at a great many objects at a time, while it can *grasp* only a very few; so that nature and parental discipline combine to diminish the pleasure of feeling shapes, and to increase the pleasure of seeing shapes. For the faculty which has the most numerous and varied opportunities of exercise will always be that which brings the greatest enjoyment; so that baby learns to prefer lines followed by the eye to lines followed by the hand. The bird, of course, has no choice, for she possesses no instrument of touch which can trace out forms.

But all kinds of contours will not be equally liked. Curved lines afford an exercise more varied than that given by straight lines, and less fatiguing than that given by angles. Herbert Spencer observes that "the delight in flowing outlines rather than in outlines which are angular, is partly due to that more harmonious, unstrained action of the ocular muscles implied by the perception of such outlines; there is no jar from sudden stoppage of motion or change of direction, such as results in carrying the eye along a zigzag line." Another example, be it noted, of the principle of smoothness. Mr. Sully carries out a similar idea with more detail.* He shows that "gradation in direction, which is at the basis of all curvilinear movements, depends on a gradual alteration in the relative degrees of activity of two or more muscles, and so corresponds to gradation in colour or tone, which is supposed to rest on a gradual increase of activity in certain nerve elements, and decrease in others." He further points out that a straight line is the easiest to follow, and therefore gives a certain negative comfort, and that the pleasure taken in symmetry may be partially explained by the harmony in the movements of the two eyes, and by the relationship which the parts of a symmetrical object seem to bear to a real or imaginary centre. "Owing," he says, "to the structure of the retina, the centre of an object, or group of objects, is naturally raised to a place of honour."

Yet the purely physical gratification derived from varieties of form is probably less vivid than the corresponding mental gratification. Not only the lower, but the higher nerve-structures, require diversified and congenial occupation. The cerebral hemispheres want to be kept active, and they exert themselves healthily and pleasurably by taking note of the similarities and dissimilarities of surrounding objects. Every fresh curve, every new kind of contour, every pattern of twining and waving and intersecting lines, is a new intellectual stimulus.

The bird is exactly at that stage of evolution where, on this theory, a taste for new combinations might be expected to attain a distinct development. Not only is the average weight of the brain in proportion to the body greater than in the lower Vertebrata, but this increased weight is chiefly due to the greater development of the cerebral hemispheres. Yet the hemispheres are still unconvoluted, and the intellect correspondingly simple, so that the stimuli which it craves must be elementary, abundant, easily assimilated. These conditions are satisfied by those freaks of conformation which catch the keen eye and fix the practised attention of the bird.

We now begin to see why the hen is pleased where one of her lovers develops a new streak or spot or eye of colour, or a tuft of feathers arranged in an unhackneyed and conspicuous fashion. She likes vivid sensations and vivid ideas. It is a joy to be alive, and to be as much alive as possible she must have her faculties brought into vigorous play. So she chooses the mate who will best satisfy this craving for fulness of life. Artist she is not. Of beauty, properly so called, she has perhaps no conception; but she is a healthy living being, who instinctively takes measures to be as healthy and as living as she can. In fact, she is a flying refutation of pessimism.

All this, as we shall see, is true under certain limitations. I can imagine that some one will object—"But has the hen-bird, like many human females, an undiscriminating admiration for 'the latest novelty'? Does she select her husband simply because the fashion of his coat is 'new this season'? If she did, would such a process of selection be more likely to lead to the evolution of the *beautiful* than to the evolution of the *queer*? Would it, indeed, lead to any evolution at all, and not rather, as in human fashion, to a capricious see-saw?"

We must remember that the possibilities of organic evolution are always limited. The human female may one year sprout out at the head, the next year at the shoulders, the third year just below the waist. In the course of a lifetime, she may indulge in every hue and every shape which has ever disguised the human form divine. The "weight of too much liberty" may be her æsthetic ruin. Yet even with her, custom counts for much, and she does not make the most of her advantages or disadvantages.

But the bird has no such power of capricious change. If he has begun to grow a crest, the chances are, not that he will begin next season to grow a ruff or a hood, but that he will develop the crest, and pass it on to his descendants. And, since the welfare of every being depends on its ability to accommodate itself to its environment, the hen-bird has wisely adjusted her ways to her means. Her hankering after novelty is checked by a deep-seated conservatism. She likes the *fresh*, but not the *strange*. The male must be recognisable as belonging to her own family, otherwise she will have none of him. Besides, she always prefers the more vigorous male, when other things are equal, and even when they are *not* equal, and this sensible preference naturally limits her choice. Albino birds are shunned by the rest of their species. Dovecot pigeons dislike all the highly-improved birds; doubtless suspecting something uncanny beneath the outlandish attire. There seems to be a good deal of individual difference in this respect, some hens being much more advanced in their ideas than others, and less imbued with tribal prejudice. A male blackbird and thrush (living in a state of nature) have been known to pair; a male widgeon chose a pintail duck; a Canada goose, living with twenty-three others of her own kind, selected a Bernicle gander; indeed, it appears that geese are peculiarly susceptible to these irregular attachments.* But such instances are exceptions to the general rule.

The evolution of the *queer* has, however, very often occurred. Behold the toucan, with its enormous and highly-coloured beak; the turkey-cock, with his solemn strut and inflated wattles; the "indescribably odd" attitudes into which the carrion vulture throws himself at the beginning of the love season. Even the delicately-adorned Argus pheasant presents a decidedly ludicrous appearance when courting, expanding his wing-feathers into an enormous fan, and pushing his head between two of them to watch the effect produced.

Still, it is natural to suppose that our idea of beauty, in its simplest form, would coincide pretty well with the bird's taste, since it has been nourished on very much the same materials. It is from contrasts of bright colour and from varieties of curved form that the baby and the bird receive their earliest visual satisfaction.

(*To be continued.*)

*"Pleasure of Visual Form" (*Mind*, April, 1880).

* "Descent of Man," p. 414.

THE COCOON OF A SPIDER.

AT a recent meeting of the Academy of Natural Sciences, of Philadelphia, Dr. H. C. McCook stated that, while walking in the suburbs of Philadelphia lately, he had found under a stone a female Lycosa, probably *L. riparia*, Hentz, which he placed in a jar partly filled with dry earth. For two days the spider remained on the surface of the soil, nearly inactive. The earth was then moistened, whereupon she immediately began to dig, continuing until she had made a cavity about one inch in depth. The top was then carefully covered over with a tolerably closely woven sheet of white spinning work, so that the spider was entirely shut in. This cavity was fortunately made against the glass side of the jar, and the movements of the inmate were thus exposed to view. Shortly after the cave was covered the spider was seen working upon a circular cushion of beautiful white silk about three-fourths of an inch in diameter, which was spun upward in a nearly perpendicular position against the earthen wall of the cave. The cushion looked so much like the cocoon of the common tube weaver, *Agalena nævia*, and the whole operations of the lycosid were so like those of that species when cocooning, that it was momentarily supposed that a mistake in determination had been made.

After the lapse of half an hour, it was found that the spider had oviposited against the central part of the cushion, and was then engaged in enclosing the hemispherical egg-mass with a silken envelope. The mode of spinning was as follows: the feet clasped the circumference of the cushion, and the body of the animal was slowly revolved; the abdomen, now greatly reduced in size by the extrusion of the eggs, was lifted up, thus drawing short loops of silk from the expanded spinnarets, which, when the abdomen was dropped again, contracted, and left a flossy curl of silk at the point of attachment. The abdomen was also swayed backward and forward, the filaments from the spinnarets following the motion as the spider turned, and thus an even thickness of silk was laid upon the eggs. The same behaviour marked the spinning of the cushion, in the middle of which the eggs had been deposited. The ideas of the observer as to the cocooning habits of Lycosa were very much confused by an observation so opposed to the universal experience. Upon resuming the study after the lapse of an hour and a half, he was once more assured of being right by the sight of a round silken ball dangling from the apex of the spider's abdomen, held fast by a short thread to the spinnarets. The cushion, however, had disappeared. The mystery, as it had seemed, was solved; the lycosid, after having placed her eggs in the centre of the silken cushion and covered them over, had gathered up the edges, and so united and rolled them as to make the normal globular cocoon of her genus, which she at once tucked under her abdomen in the usual way.

This was a most interesting observation, which Dr. McCook believed had not before been made. The manner of fabrication of the cocoon of Lycosa had been heretofore unknown to him, and, by reason of her subterranean habit, the opportunity to observe it was of rare occurrence. He had often wondered how the round egg-ball was put together, and the mechanical ingenuity and simplicity of the method were now apparent. The period consumed in the whole act of cocooning was less than four hours; the act of ovipositing took less than half an hour. Shortly after the egg-sac was finished, the mother cut her way out of the silken cover. She had evidently thus secluded herself for the purpose of spinning her cocoon.

Dr. McCook also alluded to another interesting fact in the life history of the Lycosa, which had been brought to his attention by Mr. Alan Gentry. A slab of ice having been cut from the frozen surface of a pond about eight or ten feet from the bank, several spiders were observed running about in the water. They were passing underneath the surface, between certain water plants. It is remarkable to find these creatures thus living in full health and activity in mid-winter, within the waters of a frozen pond, and so far from the bank in which the burrows of their congeners are commonly found. It has been believed heretofore, and doubtless it is generally true, that the lycosids winter in deep burrows in the ground, sealed up tightly to maintain a higher temperature.—*Scientific American.*

CHAPTERS ON MODERN DOMESTIC ECONOMY.

XXVI.—THE FRAMEWORK OF THE DWELLING-HOUSE.

STRUCTURAL EXAMPLES (*continued*).

THE DISPOSAL OF HOUSEHOLD REFUSE.

AS a general rule, the traps and soil-pipes of a house are made of metal, and are hence, sooner or later, liable to corrosion; the destructive influence of sewer-gases is most manifest at angles or sharp bends. An ordinary, well-ventilated leaden soil-pipe will last from 18 to 30 years; an unventilated pipe of the same material, drawn, and not soldered, succumbs after from 8 to 20 years. Iron pipes do not last so long, and zinc is to be condemned altogether, since its use leads to most uncertain and invariably bad results; facts which are attested to by many examples now deposited in the Parkes' Museum of Hygiene. From these memoranda our readers will conclude that stoneware traps and pipes ought always to be substituted, especially as we have already given excellent examples in former chapters; but stoneware pipes and traps are not always easily procurable, and, when so, are oftentimes left alone by the metal-working plumber, whose name is not amiss since he likes to work most of all with lead. Hence the necessity has arisen for leaden articles of dependable value, since they can be easily applied to the wants of the majority of existing cases.

Last week we gave a brief description of the prevalent and most defective so-called "D-trap," which is now condemned by the model laws of the Local Government Board; it remains for us to point out what ought to be done in case one of our readers should find such a structure in his house. He may with safety remove it, and place in the gap an ordinary "S-trap," or a "Half-S-trap," commonly known as a "P-trap." There are a great many makers of these traps; but, for the reasons we have stated above, it would be found that the views of the reader and his plumber are likely to be both agreeably met if some firm were to construct traps out of lead in such a way as to resist the action of sewer-gases for such a length of time that the trap may prove to be really economical and safe. Messrs. Beard & Dent have taken upon themselves this task with a successful issue; their traps are made of the softest and purest pig-lead, without any seam or solder; they are perfectly smooth both within and without, and are so strong that each superficial foot of the trap contains no less than 8 lb. of metal. Perhaps, however, the best trap now made of the class of substitutes which we are now commenting upon is Hellyer's patent cast-lead "Anti-D Trap." It is made upon the principles we have just quoted, but has a decided advantage in shape, which may be likened to

the letter D inverted thus—U, with a small semi-partition projecting downwards from the centre above. This partition dips into the water in the trap, and forms a dip-trap with a water-seal of 1¾ in. in depth.

Where, however, it is found advisable to do away with not only the trap but the pan closet as well, and to have an entirely new fitting adequately trapped, there cannot be any dispute that a sound stoneware apparatus, combining all extra appliances, such as means for thorough flushing, traps, and valves, ought to be selected, and we shall therefore give a few special examples here. At p. 23 of the "Guide to the Sanitary and Insanitary Houses," which was published last year for the executive council of the "International Health Exhibition," the requisites of a healthy closet are tersely given thus:—"Good position. Plenty of light and ventilation. Good form of apparatus. Ample water supply, special 'Intercepting cistern.' Hinged seat to be raised when pouring slops into basin. Lead safe in case of accident, falling to waste-pipe which discharges into open air." From this it will be gathered that the floor underneath the closet is to be protected by a lead safe, the use of which is to provide against accident to the floor and ceiling, if any, of the room beneath through leakage from any of the taps: in this case the waste water from the safe is made to discharge into the open air through a special pipe which acts as a warning pipe, and which ought to be provided at its outlet with a brass flapper to prevent a draught from entering under the seat. A good closet ought also to have a hinged seat as stated above, and then a "Queensware Slop Top" of approved shape, such as that shown at Fig. 25, can be placed below the seat.

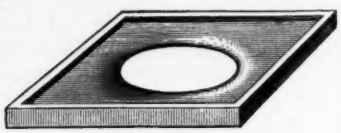


Fig. 25.

Of other accessories, an "Intercepting Cistern" of approved form holds a most important place. It ought to effect a careful flushing of the closet and prevent undue waste of water. About two gallons of water ought to be discharged each time by merely pulling the handle or by the action of the seat; the water ought to continue to flow even after the handle has been released, and the final flush should be as strong, if not more powerful, than at its start. The mechanical parts, moreover, ought to be protected from the entry of rubbish, such as straw, leaves, &c., which are liable at all times to clog the working parts; and lastly, while the flushing is going on, the intercepting cistern ought to be refilling. In every case, the pipe between the flushing cistern and the closet should be of large size, about 1½ inch in diameter, so as to afford an easy and effectual downflow of the discharged water.

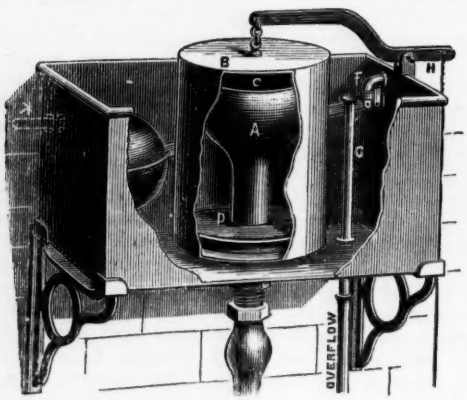


Fig. 26.

We shall not linger here to give a detailed description of the numerous inventions which fulfil all the demands noted above, save to mention one of the best forms hitherto introduced and known as Doulton's Patent "Vacuum" Water-Waste Preventor (Fig. 26). When the lever H is pulled down, the cylinder B is thereby raised, and draws up a sufficient quantity of water into the mouth C to start the annular syphon. The action of this is to cause a discharge of two gallons of water, the flushing power of which is greatest at the end of the flow.

In our next communication we shall give an illustrated description of the working parts of some of the best varieties of closet apparatus which may be adopted in lieu of existing defective forms.

THE ORIGIN AND HOME OF THE DIAMOND.

By W. JEROME HARRISON, F.G.S.

NO substance is more admired, and certainly no substance is more mysterious than the diamond. Up to a hundred years ago it was generally believed to be a peculiar kind of rock crystal, although Newton made a shrewd guess as to its true nature when, from its remarkable power of refracting light, he inferred it to be an "unctuous substance coagulated," classing it with camphor and other bodies which are rich in carbon.

In 1694, certain members of the Florentine Academy concentrated the rays of the sun, by means of a powerful lens, upon a small diamond, and were surprised to see the precious stone become gradually smaller, until at last it disappeared altogether.

But the great French chemist Lavoisier set at rest all doubts as to the true chemical composition of the diamond when, in 1777, he burnt it in a confined portion of air, and found that nothing but carbonic acid gas resulted from its combustion. Carbonic acid gas is a compound of oxygen and carbon—the air had furnished the oxygen, and the diamond the carbon. Great hopes were now entertained that diamonds might be made by the bushel; and there are so many useful purposes to which this hardest of all known substances might be applied, if it could be more cheaply obtained, that such a discovery is a very desirable one. But although more than a century has now elapsed since Lavoisier's discovery, all attempts to manufacture diamonds have practically been failures. The reason of this is that the diamond is *crystallised* carbon. Now, to obtain a substance in the crystalline condition, it is generally necessary either to dissolve it or to melt it. But carbon will not melt under the greatest heat to which we have hitherto been able to subject it; neither is there any known solvent for it.

Of the many attempts which have been made by skilled chemists to produce artificial diamonds, the only success belongs to Mr. J. B. Hannay, of Glasgow. In the year 1880 this gentleman announced that he had succeeded in preparing extremely small specimens of crystallised carbon. Mr. Hannay's method consisted in subjecting a hydrocarbon to a red heat at the same time that it was under a great pressure, in the presence of a stable compound containing nitrogen. For this purpose he placed some bone-oil with a little of the metal lithium in a stout iron tube 4 inches external diameter, but having a bore of only half-an-inch. The ends of the tube were welded up, and it was then placed in a furnace and kept

at a red heat for several hours. Out of eighty experiments only three were successful, the great pressure exerted by the confined gases frequently bursting the tubes; while another source of disappointment lay in the fact that many of the iron tubes proved to be *quite porous* when red-hot, so letting the gases escape. When everything went on properly the bone-oil was decomposed, its hydrogen being attracted by the lithium, while the carbon was deposited on the bottom of the tube as a black mass containing microscopic diamonds. Although the cost of the diamonds produced in this manner was many times greater than the sum for which they could have been obtained at a jeweller's, yet the result was of the highest theoretical interest and importance.

DIAMANTIFEROUS LOCALITIES.

Up to about two centuries ago, India was the principal, if not the only known home of the diamond. The diamond mines occur in the Deccan, an elevated tableland in the southern part of India, the gems being found in a coarse gravel which is probably derived from sandstone-rocks belonging to the Lower Silurian formation. Golconda, so frequently referred to as the home of the diamond, never produced any diamonds at all, being merely the mart to which the diamonds were brought to be sold. When India was governed exclusively by native princes, who disposed of the labour of their subjects as they thought fit, the digging and washing of the diamond-gravels of the Deccan yielded a large number of the precious stones. Now that the Hindoo labourer requires a suitable wage, and is protected from oppression by the British Government, the search for diamonds in India is found "not to pay." Of all the precious stones found in India, the Koh-i-noor is, perhaps, the best known to us, because it now occupies the place of pride among the jewels belonging to the Crown. It is believed to have been found in the mines at Kollur, and its original weight was 790 carats. When the traveller Tavernier saw it in the possession of the Great Mogul (Aurungzebe), in 1665, it weighed only 280 carats, and it is believed that the cutter (Borgio, a Venetian), to whom it was entrusted, detached by cleavage more than one fragment, which he converted to his own use. After several vicissitudes, this "Mountain of Light" was confiscated by the East India Company in 1850, and presented to the Queen. Its weight was then 186 carats, but the recutting, by Coster of Amsterdam, further reduced it to 106 carats. Owing to the unskilful way in which this fine gem has been treated, its lustre is still unsatisfactory.

The diamonds of Brazil were discovered early in the eighteenth century in the province of Minas Geraes. They were obtained from the *cascalho*, a coarse gravel produced by the decay of a quartzite or hardened sandstone. To this sandstone itself the name of *itacolumite* has been given, and diamonds have been found in the solid rock. But as we know sandstones to be formed by the wearing away of older rocks, it is uncertain whether the diamonds have been produced in the itacolumite, where we now find them, or whether they are there simply as natural ingredients of the rock, like the grains of sand of which it is mainly composed.

Between the years 1772 and 1818 diamonds to the weight of three million carats, and worth £7,000,000, were exported from Brazil. But as the deposits began to be worked out, the produce was far less, and the value of the stones exported between 1861 and 1867 was under two millions sterling. Since the latter date, the Cape diamonds have caused a still greater reduction in the extent and value of the Brazilian mines. The Brazilian diamonds are mostly small, the largest known, the "Star of the South," weighing 254 carats, which was reduced to 124 carats after cutting and polishing. Besides dazzling brilliants, the mines of Brazil have yielded an impure black form of crystalline carbon, called *carbonado*, which occurs in lumps sometimes 2 lb. in weight. These black diamonds are now much used in boring operations, being set at the end of a crown or cylinder of steel, which is made to revolve rapidly by steam-power. By this means hard rocks are penetrated with comparative ease, and borings to depths of from one thousand to two thousand feet have been executed at a greatly reduced cost, and in a less space of time than previously.

Of other localities from which diamonds have been obtained we can here only briefly allude to Australia, where large numbers of small stones have been found since 1852 in the alluvial deposits from which so much gold has been washed; the Ural Mountains, where the precious stones are associated with gold and platinum; and Borneo, where the Rajah of Mattam is said to possess a diamond weighing 367 carats. The diamond-fields of South Africa, which have thrown all the other "diggings" completely into the shade, we shall now proceed to describe with more detail. Before leaving the other diamantiferous regions we may, however, note that the diamonds they yield appear almost invariably to occur in gravels derived from ancient and metamorphosed rocks, and that gold—derived from the same source—almost invariably accompanies the gems. The seeker for rough diamonds must divest himself of the idea that they possess the sparkle and brilliancy of the cut and polished gems; the fact is, that they mostly look like bits of hardened gum!

(To be continued.)

GEORGE ELIOT ON OLD AGE.

IN the *New York Tribune*, Mr. Robert Buchanan publishes an interesting account of a conversation with George Eliot and Mr. Lewes. In the course of this conversation, the subject of old age was raised, and the following suggestive remarks were interchanged:—

George Eliot—*Quem Di diligunt*, &c. After all is not Ganymede to be envied? Better to be snatched up suddenly into the heaven of heavens, in all the prime of youth and happiness, than to grow old in a world which is full of sorrow, and in which old age is the least beautiful of human phenomena.

Lewes—You are quite right there. It is the exaggeration of sentiment which makes the poets give old age a sort of moral halo. There is nothing so pitiful, so horrible, as the slow and certain decay of the human faculties.

Buchanan—But is not that decay beautiful too?

Lewes—Apart from the pathetic fallacy, as Ruskin calls it, not at all. Your favourite Catullus describes it perfectly:—

> Cana tempus anilitas
> Omnia omnes annuit!

In other words and Scotch ones, "a' nodding, nid-nid-nodding;" a condition, in short, of ever-increasing imbecility, or vacuity.

George Eliot (smiling)—We are wandering toward deep waters. But it is quite true, I think, that the gradual obliteration of the human faculties and senses, one by one, is the strongest argument against the popular conception of a personal immortality.

Lewes—Certainly.

George Eliot—Not only do men, under circumstances of physical decay, become feeble and imbecile; when a moral sense remains, it frequently becomes perverted. I have seen an old gentleman, hitherto known as an immaculate

and honest merchant, gradually acquire habits of kleptomania, and another, well known for his benevolence, become spiteful, almost homicidal. We are absolutely the creatures of our secretions. So true is this, that the slightest disturbance of the cerebral circulation — say a temporary congestion — will pervert the entire stream of moral sentiments.

Buchanan—All that is doubtless very correct. I hold, nevertheless, that the soul, the Ego, is invulnerable, despite all temporary aberrations — clouds obscuring the moon's disc, so to speak.

George Eliot—Say rather, disintegrations within the very substance of the moon itself. Where the very substance of the luminary is decaying, what hope is there for the permanence of your—moonlight?

Buchanan—The analogy is imperfect; but to pursue it, the lunar elements remain indestructible, and after transformations, may cohere again into some splendid identity.

George Eliot—Moonlight is sunlight reflected on a material mirror; thought, consciousness, life itself, are conditions dependent on the physical medium and on the brightness of the external environment. *Cogito, ergo sum* should be transposed and altered *Sum materies, ergo cogito.*

Lewes—And yet, after all, there are psychic phenomena which seem to evade the material definition!

George Eliot—Not one. And science has established clearly that, while functional disturbance may be evanescent, structural destruction is absolute and irremediable. An organism, once destroyed, is incapable of resurrection.

Buchanan—Then life is merely mechanism, after all?

George Eliot—Undoubtedly. It is very pitiful, but absolutely true.

Lewes—But what mechanism! How wonderful, how perfect in its adaptation of means to ends! Even if we hold thought to be a secretion, does that lessen the beauty of its manifestations?

Buchanan—Or the mystery of its origin?

Lewes—Humph!

George Eliot—The mystery, doubtless, consists only in our ignorance. There was a time, not very long ago, when men knew nothing of that marvellous truth, the circulation of the blood. In time, no doubt, we shall discover the precise process by which we think.

CLIMBING PLANTS IN TREES.

THESE give an appearance of robust luxuriance and unrestrained vigour, reminding the spectator of those tropical and semi-tropical climes where nature, under the influence of perpetual heat and moisture, runs riot, producing oftentimes vegetable giants. Some of the most astonishing of these are the climbing plants that ascend the tallest trees of the forest in search of light and space where they can develop their foliage and flowers, travelling from tree to tree, and some throwing out roots in the air that reach to the earth, there taking fresh roothold, and extending still further in their stem-growth. Our plants, checked in their growth by frost and cold through half the year, cannot vie with these tropical inhabitants of the jungle and the forest, and our nearest approach to them is to be found in the larger forms of ivy, in Ampelopsis hederacea, in Wistaria sinesis, the vine, clematises, and Periploca Græca. But the largest and strongest of our climbers, the one that approaches the nearest to these, is Aristolochia sipho. Smaller creepers we have in abundance, but our purpose is with the most rampant ones, good for ascending our biggest trees. When once this becomes established, it will grow fast enough.

It is no use to merely dig a hole at the tree-root and stick the plant in, expecting it will do well; but a good-sized hole must be got out near the stem. There are no fibrous roots in that part to draw the goodness out of the soil you give, unless the tree is young, and in that case you had better plant no creeper; or better, a hole may be made some distance off, training the main shoot underground when it has got as thick as the thumb, in the meantime allowing it to grow attached to a stake for support. If merely assisted in its upward climb with a tie here and there, this plant will quickly reach the summit of a tree 50 feet high; it will not then strangle a tree like ivy with its clustering, thick growth, but will creep outward, if the tree is a solitary one, to the extremities of the limbs, letting fall slender shoots and festoons of handsome, broad, heart-shaped foliage, and in warm summers an abundance of its curious pitcher-like brown flowers. Ampelopsis hederacea sorts make a good creeper, the growth being rapid, and its autumn tints most gorgeous. This is not a self-clinging plant, and must, therefore, have assistance at first, although later the interlacing stems clasp the stem and branches of a tree, and will merely require that its leading shoots be led upward and outward.

A. tricuspidata or Veitchii is a very handsome kind, but is less suited to climb a tree than to drape a low fence, the pediment of a statue, or a vase, or to be allowed to cover a low stump or pillar, and having, contrary to the other kinds of ampelopsis, a clinging habit, it gets on without much assistance. Periploca Græca is a most hardy, quick-growing, deciduous creeper, growing to great lengths in one season; the foliage is deep green in colour and lanceolate in form. This is fit for any place where a creeper is desirable; the flowers are inconspicuous, and purplish in colour. The clematis, vine, ivies, honeysuckles, and wistarias are too well known to need description, although it may not be amiss to note that Clematis flammula is one of the very fastest growers, and has deliciously-scented white flowers, which appear in immense bunches on old plants.

C. vitalba should also be mentioned—indigenous to our country, and found in our southern hedgerows, smothering other plants out of existence. The trumpet honeysuckles, Bignonia radicans, and some such roses as Boursault, Prairie Rambler, Ayrshire, and Jasmine are all good in positions where there is much light, as the beauty of all these few last consists more in their flowers than in the foliage, so that as simple climbers rampant and full of leaf those mentioned at the beginning of this article are the best for the purpose.—*Gardeners' Chronicle.*

According to a paper read before the Philosophical Society of Glasgow, by Mr. A. Williamson, the total area of the coal-fields of China proper is about 400,000 square miles. Both the Shansi and Heenan coal-fields are greater than that of the aggregate of the principal coal-producing countries of Europe, and in other districts of North China the coal-fields are said to be seven times larger than all those of Great Britain. The coal is of various descriptions, and it is said that iron ores are found in all parts in close proximity to the coal.

Royal Victoria Hall and Coffee Tavern.—There is an excellent programme for May at the above hall. Ballad concerts will be given on Thursday evenings. The Tuesday science lectures will be:—D. Dullenger, on "Wonderful Things we do not Personally See," on the 12th; Professor Perry, on "The Spinning-Tops of Japan and Other Countries," on the 19th. The management have decided to lower the prices of admission in April and May. In June and July, Messrs. Poole will show, in this hall, their grand diorama of "Egypt and the Soudan War," with life-sized pictures.

THE ELECTRIC LIGHT AT THE INVENTIONS EXHIBITION.

WERE the International Inventions Exhibition to prove a disastrous failure in every other respect, its success as a grand display of the far too latent powers of electricity as a source of light is more than assured. That this due in a great measure to the masterly direction of Mr. Gooch no one can doubt; but were the electric light so barren, so unpracticable, so unreliable as is persistently pretended by its opponents, no man under the sun could impart to it the vitality it now shows itself to possess or the feelings of security and comfort which surround it. True, the electric light has not heretofore shown that amount of progress which it should have done, but there are reasons for this easily discernible. In the first place, the speculation which it gave rise to some three years ago has hampered its progress a great deal, although it is high time that the depression so caused should have passed away. The incompetence and inexperience of those entrusted with its introduction into public favour and patronage have, so far as we can see, had a very injurious effect upon it. The bungles and shortcomings of those gentry have not been few, nor have they been far between. The most elementary principles which should be recognised in the erection of electrical circuits have been frequently ignored, and with results that should fairly have been anticipated. But still another cause of the trouble is that few of the companies have recognised their true mission. They have strained at camels before they were prepared to swallow gnats. Conceive the absurdity of a body of business men essaying to light London and its suburbs for miles around, and having in their coffers but a few paltry thousand pounds. Financially, they were unqualified for the work, and from an engineering point of view they were in a similar predicament. In this respect the introduction of the electric light reminds one very forcibly of the pioneering days of gas-lighting, when companies attempted to light towns of 25,000 inhabitants with a capital of £5,000. A due regard for these sins of commission and of omission, which have caused many a man the loss of his hard-earned savings, convinces us that the present function of the electric light is for isolated work—that is to say, the thing first to be attended to is the erection of plant for feeding a thousand or two incandescent lamps, or a score or two arc lamps. Such installations there is room for all over the country, to say nothing of the immense sphere that presents itself in ocean-going steamers. It is probable, indeed, that more work has been done afloat, and more lamps erected by English houses are employed on board ship than on shore. The various exhibits at South Kensington make it very apparent that electricians have now so far advanced in their craft as to be able to attack installations of the character indicated with every prospect of success.

The number of systems exhibited is twenty-four, the particulars of which are detailed in the table on next page. These systems are distributed throughout the Exhibition buildings, and in a portion of the grounds, a plan of the Exhibition being furnished, in which this distribution is clearly indicated. It will be seen that besides the 1,150 Edison-Swan lamps, there are no less than 2,680 Swan lamps employed by other exhibitors. Altogether there are over 6,000 incandescent lamps and about 400 arc lamps. The conditions under which the installations are fitted and worked are certainly more difficult, and present more trying circumstances than are likely to be the case in actual commercial work. The shed containing the dynamos and engines covers a considerable area, the total horse-power provided by the engines being about 1,850. The progress so far made is scarcely sufficient to warrant as yet a detailed account of the various features pertaining to the different exhibits. Such installations as are completed are worthy of every commendation, and it is to be hoped that such others as put in an appearance may prove equally gratifying.

The masterpiece in the way of electrical engineering is the installation by Messrs. Siemens Bros. for illuminating the major portion of the grounds. This is independent of the general arrangement, and is the subject of a special contract. It is to take the place of the Chinese lanterns and other gala impedimenta which, at enormous trouble and inconvenience, illuminated the grounds last year. The installation at present consists of 9,000 Swan lamps of 5 and 10 candle-power, and a few others of 20 candle-power, which are fixed on the band-stands and the verandah around the conservatory. The lamps, in accordance with the design of Sir F. Bolton, have been placed partly on the permanent buildings and on the conservatory, with a view to bringing out the tracery of these buildings, and to give an appearance of vastness to the grounds, and partly on the balustrades round the flower-beds and in the trees of the gardens. The lamps are divided into twenty-three circuits, each of which is coupled-up to a switch, by means of which the lamps may be either extinguished or their luminosity reduced by the insertion of resistance into the circuit. The lamps are distributed thus:—

Conservatory	1,500 lamps
East and West Quadrants	1,500 „
Upper Garden, Trees, and Balustrades	1,360 „
East and West Arcades, Chinese Pavilion, Machinery Shed, and Trees	2,000 „
Lower Gardens, Side Ponds, Beds, and Pendants	1,200 „
Albert Statue, Centre Pond and Balustrades, and Band-stands (interior)	1,450 „

The current is produced by three of Siemens' B 13 self-regulating dynamos, each giving a current of 450 ampères of 250 volts, the armature making 300 revolutions per minute. These machines are the largest of the kind ever exhibited to public notice. They weigh about thirteen tons each, their height being 8 ft. 9 in., length 8 ft., and width 4 ft. 8 in. The armatures are wound with flat strips of copper, instead of wire.

Each dynamo is coupled direct to one of Goodfellow & Mathews's high-speed compound triplex engines fixed on the same bed-plate, and having three high and three low pressure cylinders placed two and two at an angle of 60°. The height above the bed-plate is 6 ft. 6 in., length 7 ft. 6 in., and width 7 ft. 7 in., the weight being 5 tons. Each engine gives an indicated horse-power of 180, with 300 revolutions per minute, and steam at 120 lb. pressure. These details are here embodied as evidence of the great work which is being performed in the West Quadrant (close to the conservatory), and those of our readers who visit the Exhibition will find ample reward for whatever trouble they may be put to in inspecting the work. It may be mentioned that two of the dynamos will be sufficient to illuminate the lamps so far contracted for, but the third will be kept running in readiness for any emergency. Means are also provided for speedily reducing the number of the lamps in the event of only one dynamo being available, and that without altering the general design of the installation.

In the east arcade, a large portion of which is devoted to electricity, will be found a number of interesting collections by various exhibitors, of which one claims our attention. This is a special stand of Swan lamps, exhibited

ELECTRIC LIGHT INSTALLATIONS AT THE INVENTIONS EXHIBITION.

Exhibitor.	Type of lamp.	Actual candle-power.	E.M.F. of lamp.	Number of lamps.	Position and remarks.
Crompton & Co.	Crompton-Crabb DD arc lamps...	3000	—	6	South Promenade. Lamps in pairs on three masts.
„ „	Woodhouse & Rawson incand. ...	20	100	300	Old London Houses. New Crompton dynamo and Willan's engine.
Edison-Swan Co.	Edison & Swan incandescent	10	150	400	Entrance.
		20	100	750	South Court, S. Gallery.
Paterson & Cooper	Bernstein incandescent	50	46	270	Dining-rooms, S. Gallery.
„ „	J. F. Pattern arc lamps	650	—	24	West Annexe.
Siemens Brothers	Swan incandescent	20	46	1080	Middle Court, S. Gallery.
„ „	Siemens arc lamps	—	—	12	For fountain display.
„ „	Siemens arc lamps	5500	—	4	Conservatory. Same as last year.
Anglo-American Brush Co.	Victoria incandescent	20	60	750	North Court, S. Gallery.
„ „	Sellon-Brush arc lamps	3000	—	24	Queen's-gate Annexe. All 24 lamps on one circuit, driven from Brush machine with new armature.
Goolden & Trotter	Woodhouse & Rawson incand.	20	100	300	Austrian Court. Current supplied by new Goolden & Trotter dynamo.
„ „	Hochhausen arc lamps	3000	—	6	All the six lamps on one mast over Royal Balcony.
Elwell-Parker, & Co.	Swan incandescent	20	100	200	Royal Pavilion. Elwell-Parker dynamo and accumulator.
Mackie	Lea arc lamps	2700	—	5	Old London street. Three lamps fixed to houses, and two lamps hoisted on two masts.
*Andrewes & Co.	Andrewes arc lamps	1000	—	16	Shed containing machinery for Electric Lighting.
Clark, Chapman, & Co.	Swan incandescent	20	100	200	Refreshment bar.
Jablochkoff Electric Light Co.	Jablochkoff candles	350	—	60	South Central Gallery.
Gülcher Electric Light Co.	Swan incandescent	20	45 & 50	750	Aquarium. (Gülcher dynamo.)
„ „ „	Gülcher arc lamps	700	—	52	Central Gallery. All the arc lamps in parallel; fed by Gülcher dynamo.
„ „ „	Swan incandescent	20	45	250	Chinese Restaurant, Tea-rooms. All lamps parallel; fed by Gülcher dynamo.
Goulard & Gibbs	Varley lamps and Maxim incand.	200	—	30	East Arcade and West Gallery, Concert-rooms. Lamps, &c., worked by secondary generators on one main circuit.
Pilsen-Joel Co.	Pilsen arc lamps	780	—	42	West Gallery.
Cordner, Allen, & Co.	Thornton arc lamps	650	—	30	West Central Galleries. Arc and incandescent lamps in parallel.
Maxim-Weston Co.	Weston arc lamps	2000	50	20	East Central Galleries.
Thompson-Houston	Thompson-Houston arc lamps	800	—	40	East Gall. Two Thompson-Houston machines.
		500	—	18	
Fox & Co.	Fox Arc Lamps	2000	40	6	East Annexe.
Clark-Bowman & Co.	Arc lamps	700	—	12	East Quadrant and West Quadrant.
Sun Lamp Co.	Sun lamps	1100	—	32	Cheap dining-rooms.
Woodhouse & Rawson	Woodhouse & Rawson incand.	20	100	300	West Quadrant.
W. H. Allen & Co.	Swan incandescent	20	100	200	Tea and coffee stalls adjoining North Court. Slow-speed dynamo, driven direct by twin engine.
Consolidated Electric Co.	Consolidated incandescent	20	60	200	East Quadrant. Lamps arranged in groups on the B.T.K. system.
Property of Exhibition Commissioners	Swan Incandescent	120	80	50	Subway. Two Elwell-Parker Machines.

* This exhibit, it is feared, will not be made, as the firm has not complied with the stipulations made by the Commissioners.

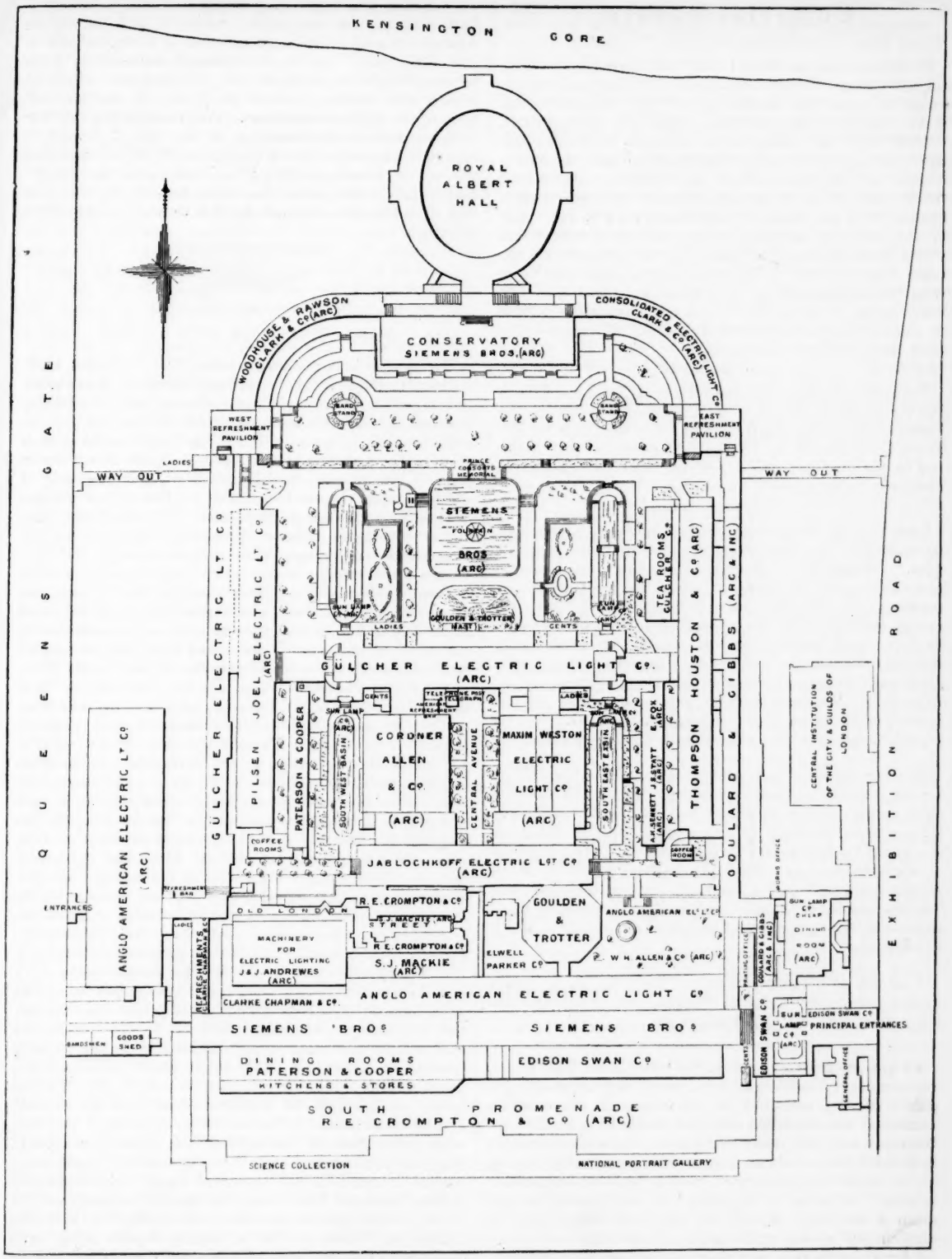
by the inventor, Joseph Wilson Swan, of Bromley, Kent, illustrating all the various types of these lamps, their special features and various practical applications.

Numerous specimens of the well-known ordinary Swan lamp are shown in different styles of ornamental fittings, the cut glass electroliers and pendants being lent by Messrs. Osler, and the brass fittings by Messrs. Faraday and Messrs Winfield.

A novelty in the use of incandescent lamps shown here consists of an orange-tree, in which the oranges are illuminated internally by Swan lamps. A surgical lamp for illuminating the internal cavities of the living body during operations is also exhibited, together with specimens of miners', divers', microscope, dental, and fairy lamps. Among Mr. Swan's recent inventions here shown, are an electric meter, consisting of the combination of a clock and a galvanometer, which indicates on dials, similar to those of a gas-meter, the amount of electricity used by each consumer; and specimens of a new filament, for making the carbons of incandescent lamps, which is produced from a liquid by pressure through a die. This latter invention is patented, and is the property of the Edison & Swan Company.

Other recent inventions of Mr. Swan's, also exhibited, are improved safety catches, new designs of switches, subways for electric light mains, and improvements in storage batteries. There is also to be seen at this stand a testing apparatus illustrating the effect of different electric potential on the light given by the lamps.

The three arches in the middle of the East arcade on


KENSINGTON GORE
ROYAL ALBERT HALL
QUEENS GATE
EXHIBITION ROAD
CONSERVATORY SIEMENS BROS. (ARC)
WOODHOUSE & RAWSON CLARK & Co (ARC)
CONSOLIDATED ELECTRIC LIGHT Co
CLARK & Co (ARC)
WEST REFRESHMENT PAVILION
EAST REFRESHMENT PAVILION
WAY OUT
WAY OUT
PRINCE CONSORTS MEMORIAL
SIEMENS FOUNTAIN BROS (ARC)
TEA ROOMS GULCHER Co
GOULDEN & TROTTER HASTINGS
GULCHER ELECTRIC LIGHT Co (ARC)
GULCHER ELECTRIC LT Co
PILSEN JOEL ELECTRIC LT Co (ARC)
PATERSON & COOPER
SOUTH WEST BASIN
CORDNER ALLEN & Co (ARC)
CENTRAL AVENUE
MAXIM WESTON ELECTRIC LIGHT Co (ARC)
SOUTH EAST BASIN
THOMPSON HOUSTON & Co (ARC)
GOULARD & GIBBS (ARC & INC)
CENTRAL INSTITUTION OF THE CITY & GUILDS OF LONDON
ANGLO AMERICAN ELECTRIC Lt Co (ARC)
COFFEE ROOMS
JABLOCHKOFF ELECTRIC Lgt Co (ARC)
ENTRANCES
OLD LONDON STREET
R.E. CROMPTON & Co
S.J. MACKIE (ARC)
GOULDEN & TROTTER
ELWELL PARKER Co
ANGLO AMERICAN EL Lt Co
W.H. ALLEN & Co (ARC)
MACHINERY FOR ELECTRIC LIGHTING J & J ANDREWES (ARC)
CLARKE CHAPMAN & Co
ANGLO AMERICAN ELECTRIC LIGHT Co
SUN LAMP Co CHEAP DINING ROOM (ARC)
GOULARD & GIBBS (ARC & INC)
EDISON SWAN Co LAMP Co (ARC)
EDISON SWAN Co PRINCIPAL ENTRANCES
SIEMENS BROS
SIEMENS BROS
DINING ROOMS PATERSON & COOPER
KITCHENS & STORES
EDISON SWAN Co
SOUTH PROMENADE R.E. CROMPTON & Co (ARC)
GOODS SHED
SCIENCE COLLECTION
NATIONAL PORTRAIT GALLERY

each side of the Swan stand are lighted by forty-four 100-candle-power Swan lamps, supplied for the purpose by the Edison & Swan Co., and fitted, two in each, to handsome crystal hanging lanterns lent by Messrs. Osler.

Editorial Gossip.

Everyone who has visited that most novel, instructive, and interesting exhibition, the Japanese Village, at Knightsbridge, will hear with sincere regret of its total destruction by fire last Saturday morning. That the Village itself, constructed of such inflammable materials as bamboo and paper, should have speedily succumbed to the "devouring element" of the penny-a-liner, need excite no surprise, but a subsequent result of the conflagration affords a curious illustration of the justice of my remarks on p. 243. For so, comparatively, inefficient were "twenty steamers and several stand-engines" in checking the progress of the flames that the roof of the Humphrey's Mansions, "supposed to be fire-proof (!)," was actually burned off. The plain English of the matter is that our existing fire-engines are simply the glorified squirt of Louis XIV. magnified so many times in linear dimensions.

Everyone interested in the subject of Technical Education should invest 6d. in a copy of the "Journal of the Society of Arts," for April 24, and study the paper by Mr. Henry Cunynghame on "Technical Education with reference to the Apprenticeship System," and the instructive discussion which followed its reading.

I see it stated that certain doctors in Valencia have been experimenting by inoculating people with "the choleraic virus." What this "virus" is the report omits to state; hence it may be an infusion full of Koch's bacillus—or anything else. If this is being put forth as a prophylactic against cholera and the inoculated patients should succumb to that dread malady, if subsequently attacked by it, doubtless the occasion will be seized to attempt to discredit the imperishable and invaluable labours of Pasteur in an allied field. We have, however, yet to learn whether the Spanish experiments have the same firm basis as those on which the results of the great French physiologist rest.

A most valuable and indispensable table of reference for all students of those mysterious bodies the variable stars, appears in the current volume of the *Proceedings of the American Academy of Arts and Sciences*, in the shape of a paper by Professor Pickering, entitled "Observations of Variable Stars in 1884." It contains a mass of observations made in America, England, Austria, Germany, and Sweden, and is, as I have said, really indispensable to all engaged in the study of that branch of astronomy to which it belongs.

I am not at all surprised to find that Mr. W. T. Lynn's capital little book "Celestial Motions" has already run into the third edition, which lies before me.

It appears from a report in the newspapers that a man has been committed to gaol for a month for interrupting a public auction, and that in the course of the case the auctioneer described him as "the leader of a knock-out." Inasmuch as a good many students of science often attempt to pick up books and instruments cheaply at sales, it may not be uninstructive to give here the result of inquiries as to what "a knock-out" signifies. It would seem, then, to mean a conspiracy among all the brokers attending an auction not to bid against each other, but to run up any lot for which there is anything approaching keen competition, so as to force the intending purchaser to pay an inordinate price for it. In every case, however, in which no outsider intervenes very actively, there is not, as I have said, any real competition whatever, and the article, whatever it may be, is knocked down at a nominal sum to one of the gang. At the conclusion of the sale, however, all the things so purchased are privately put up afresh among the brokers themselves, when, of course, each fetches its approximate value. Armed with this information, and a tolerable knowledge of the value of the lot or lots which he may desire to purchase, it is to be hoped that the novice in science who "has brains but no money" may be in a better position to counteract such unscrupulous and dishonourable conduct as that to which I have been referring.

Reviews.

SOME BOOKS ON OUR TABLE.

Heroes of Science: Mechanicians. By T. C. Lewis, M.A. (London: Society for Promoting Christian Knowledge. 1884.)—Pleasant in style, and crowded with interesting incident, Mr. Lewis's book cannot fail to become popular with boys of all ages. Of his ten chapters, the first is devoted to a sketch of the history of the steam-engine prior to the appearance of James Watt, the biography of whom occupies chapter two. This is followed in succession by the lives of George Stephenson, Richard Arkwright, Samuel Crompton, Henry Maudsley, Joseph Clement, James Nasmyth, Joseph Whitworth, and Charles Babbage. Where all is excellent, and where such an even vein of interest (itself, though, diverse enough) runs through the lives of the chief of those who have so materially helped to place England in proud pre-eminence as a manufacturing nation, it is not easy to make any selections for special mention; but perhaps the biographies of Sir Joseph Whitworth and of Charles Babbage are as instructive in their several fashions as any. Certainly they may be read with profit by the seniors of those for whom the work is primarily intended. In Whitworth's case the extraordinary apathy and indifference exhibited by the Government to the value of his immense improvements in the implements of war, must strike the most casual reader. Babbage is, we are inclined to think, treated somewhat too leniently by his biographer. He was a man of almost supernal conceit, who was firmly persuaded that he alone was right, and that the whole of the nation were in the wrong. He will always remain as a striking example and warning of the ineradicable evils incident on the Endowment of Research.

Essays on Economical Subjects. By Hibernicus. (Dublin: E. Ponsonby; London: Simpkin, Marshall, & Co. 1885.)—Many of the theses of political economy have been so often reiterated that they have by this time come to be regarded by a large proportion of people as axiomatic, and originality is so little looked for in their treatment that writers or compilers are content to go on copying from one another like children at a Board School doing a writing lesson. Hence we welcome a work like the one before us, in which the author dares to think for himself, and to assail some of the economical fetishes of the day, with a freshness of treatment which makes him always readable and amusing, even if his arguments do not always compel assent. In his very first essay, for example, on "Free Trade and Fair Trade," he reasons in a way that will at all events possess the charm of novelty for those who think that the sole effect of taxing imports must be to impoverish the consumer. He is equally heterodox, too, on the Malthusian doctrine, and assails Mr. George's ranting nonsense with much vigour and effect. His theory of rent,

and his examination into the causes of commercial crises will also be found worthy of perusal, while a very feasible suggestion for the reform of the Peerage is made in a "Note on the House of Lords." The solitary really weak essay of the whole ten which make up the volume before us is the concluding one, on "War;" which "Hibernicus" would apparently confine to a species of duel between two limited bodies of men. If his ideas could be carried out in their integrity, warfare must assuredly never cease from the face of the earth so long as the sun and moon endureth. There is no more offensive and transparent cant than the talk about "conducting war on Christian principles," and, if fighting be defensible at all, it should be so prosecuted as to cause the maximum amount of injury and pecuniary loss to the enemy. At any rate, though, the anonymous author of "Essays on Economical Subjects" has given us an amusing, readable, and at the same time thoughtful contribution to the discussion of matters gravely affecting our national prosperity.

Studies in Microscopical Science. Edited by ARTHUR C. COLE, F.R.M.S. (London: Baillière, Tindall, & Cox.)—Here are four more sections, forming together part three of Mr. Cole's valuable and beautiful work. Both engravings and letterpress are up to the high standard of the previous part of the book. The admirable lithograph of the jaws of a spider will delight the young microscopist.

Outlines of the World's History. By EDGAR SANDERSON, M.A. (London: Blackie & Son. 1885.)—Into 646 (or, including a copious and excellent index, into 664) pages Mr. Sanderson has contrived to compress a mass of historical information which is really astonishing. To epitomise, or to attempt to criticise in detail, such a work as this would be simply impossible. Suffice it to say here that the author appears to have availed himself of the latest researches in connection with every branch of his subject, and that while necessarily succinct, he has never sacrificed clearness and needful detail to brevity. Maps and illustrations are plentiful throughout the volume, which must prove not only of value in an educational point of view, but also useful as a handy book of reference for the general reader. We may safely recommend it in both of these aspects.

Ballooning. By G. MAY. "The Specialists' Series." (London: Symons & Co. 1885.)—Free from anything in the shape of "padding" or fine writing, Mr. May's little book contains a fair, candid, and, for all practical purposes, exhaustive history of the balloon from the first tentative attempts of the brothers Montgolfier, just over 100 years ago, down to the Renard and Krebs' machine, which did *not* sail against the wind last year, and to the subsequently described, albeit as yet practically untried, inventions of De Bruignac, Stapfer, and Kock. The application of the balloon to scientific research and to the military art form the subject of two chapters; while the risks run by the aëronaut are well illustrated by the awful stories of Pilâtre de Rozier, Crocé-Spinelli, Sivel, and Tissandier, and to a slightly less extent of Coxwell and Glaisher, in their memorable ascent in September, 1862. Every one who wishes to be *au courant* of the existing art of aërostation should buy Mr. May's small volume. By the way, it was Col. Noble (and not "Nobel") of the Royal Engineers, who was at the head of the Military Balloon department.

International Inventions Exhibition Railway Guide and Route-book for May. (London: Wm. Clowes & Son.)—If the possessor of this volume, situated anywhere within the bills of mortality (or, more rigidly, within a radius of twenty-five miles from the Metropolis), should be smitten with a sudden desire to visit the Exhibition of Inventions, it will be wholly his own fault if he does not proceed straightway to that destination by the most direct possible route. Seriously speaking, though, Mr. Somers Vine has succeeded in supplying directions regarding the means of transit to South Kensington which furnish every possible kind of information needed.

The Logic of Definition Explained and Applied. By WILLIAM L. DAVIDSON, M.A. (London: Longmans, Green, & Co. 1885.)—Under the not particularly attractive title which heads this notice, Mr. Davidson has produced a work of very considerable interest and importance to all who are concerned that thinking should be at once sound and accurate. For, to say nothing of the value of a habit of precision in logical definition as a means of intellectual discipline, there can be no doubt that no inconsiderable portion of the polemics of science, philosophy, and theology, has its origin in a slip-shod use of words, and in the employment of those whose connotations are vague and ill-determined, or which are of a more or less equivocal character. Our author commences the exposition of his subject by a chapter on words and their meanings, in which the reader will find much that is curious as to the changes of signification which many of our familiar words have undergone. We are, though, sorry to find him lending the weight of his authority to the formation of new designations by the addition of the syllable "ist" to the root-form of the substantive or verb standing for an art or science, *e.g.*, "scien*tist*" itself may be a compact form of expression for man of science, or natural philosopher, but—at all events at present—it has a cacophonous sound. We all remember the use of this suffix by poor Artemus Ward in his description of having his bust executed by a "Sculpist." In his second and third chapter, Mr. Davidson deals with definition generally, and in the fourth, on Lexical Defining, shows conclusively enough, the grave faults of our English dictionaries. Chapter V., too, on School-book Definitions, is sufficiently severe upon the shortcomings of the ordinary school reading-book. To Chapters VI., VII., VIII., and IX. we would refer those readers who favour us with such quires of philosophical and metaphysical disquisition; inasmuch as from them they may learn what pure logomachy the larger part of metaphysical argument really is. The tenth and concluding division of the volume deals with Biological Definition, and here the author is again most legitimately and justifiably severe upon existing botanical terminology. Nor does he spare the zoologists in his bill of indictment; in fact, he shows conclusively in how unsatisfactory a state scientific definition is generally. An appendix containing a sketch of the life and doctrine of that remarkable thinker Boëthius, and a well-arranged and copious index, conclude the work. We have no doubt that Mr. Davidson's volume will meet with that appreciation which it well deserves from philologists, metaphysicians, and men of science generally.

Handbook of Translation. Latin. (London: E. Stanford. 1885.)—This is a well-selected series of short passages from Latin authors, both in poetry and prose, for translation at sight into English. It seems well adapted for the use of those who have to face the ordeal of an examination.

We have also on our table from Messrs. Cassell & Co.:—*Our Own Country, Cassell's Popular Gardening, Cassell's Household Guide, The Book of Health, The Countries of the World, European Butterflies and Moths,* and the *Library of English Literature.* Also *The Medical Press and Circular, The Tricyclist, Wheeling, Bradstreet's, Le Franklin, The Sanitary News, The Gazette of the Travelling-Tax Abolition Committee, Unworthy Tactics,* and *Temperance* v. *Teetotalism.*

XUM

THE FACE OF THE SKY.

From May 8 to May 22.

By F.R.A.S.

SIGNS of solar activity are now diminishing, but still the Sun should be watched daily, as spots and faculæ may at any time appear. The aspect of the night sky may be seen in Map V. of "The Stars in their Seasons." Mercury is a morning star, but rises too short a time before the sun to be at all well placed for the observer. Venus is practically invisible during the next fortnight, a remark equally applicable to Mars. Jupiter must be looked at as soon as ever it is dark enough, as he is travelling towards the West. The planet is in "quadrature" with the Sun at 3 p.m. on the 17th, so that the student may now look out for that shading on the limb opposite to the Sun which was described on p. 102 of our fifth volume. Jupiter is still travelling in the direction of Regulus ("The Stars in their Seasons," Map IV.). The phenomena of his satellites during the succeeding fourteen days are as follow:—To-morrow night, the 9th, the observer should look out particularly for the transit of Satellite III., which begins at 11h. 56m. Unfortunately, the planet will be low down. On the 10th Satellite II. will be occulted at 8h. 46m. p.m. On the 12th the shadow of this same satellite will leave Jupiter's disc at 8h. 23m. p.m. in the twilight. On the 13th Satellite IV. will be occulted at 9h. 58m. p.m., as will Satellite I. at 10h. 25m.; while Satellite III. will reappear from eclipse at 10h. 35m. 42s. On the 14th the transit of Satellite I. will begin in bright twilight at 7h. 46m. Its shadow will follow it at 9h. 3m. The satellite will leave Jupiter's opposite limb at 10h. 6m., and the shadow at 11h. 22m. On the 15th perhaps the reappearance of Satellite I. from eclipse may be caught at 8h. 27m. 49s. p.m. On the 17th, Satellite II. will be occulted at 11h. 21m. On the 19th, the shadow of Satellite II. will enter on to Jupiter's face in twilight at 8h. 4m.; and 24 minutes later the satellite casting it will leave his opposite limb. The egress of the shadow will happen at 10h. 59m. p.m. On the 20th, Satellite III. will reappear from occultation at 9h. 33m.; only, though, to disappear in eclipse at 11h. 10m. 36s. Satellite I. will be occulted 21 minutes after midnight, but the planet will be very low down. On the 21st, Satellite I. will begin its transit at 9h. 41m.; and be followed by its shadow at 10h. 57m. The satellite will pass off at 12h. 1m. Lastly, on the 22nd, the egress of the shadow of Satellite IV. occurs at 10h. 4m. p.m.; and Satellite I. reappears from eclipse at 10h. 22m. 55s. Saturn has left us for the season. Uranus may be found from the directions so repeatedly given recently, to the west of η Virginis. The Moon is new at 3h. 17·5m. p.m. on the 14th, and enters her first quarter at 5h. 45·1m. a.m. on the 21st. Four occultations of fixed stars will occur at convenient hours during our prescribed period. The first is on the 16th, when 130 Tauri, a 6th magnitude star, will disappear at the Moon's dark limb at 6h. 31m. p.m. at an angle from the vertex of 137°, reappearing at her bright limb at 7h. 27m. at a vertical angle of 298°. On the 19th a Cancri, of the 4th magnitude, will disappear at the dark limb of the Moon at 10h. 52m. at an angle of 48° from her vertex. It will reappear at her bright limb at 11h. 15m. at an angle from her vertex of 359°. On the 20th B.A.C. a star of the 6th magnitude, will disappear at the dark limb 21 minutes after midnight at a vertical angle of 125°. The Moon will have set ere it reappears. On the 21st another 6th magnitude star, 35 Sextantis, will disappear at the Moon's dark limb at 8h. 48m. p.m. at an angle of 26° from her vertex, to reappear at her bright limb at 9h. 18m. at a vertical angle of 340°. The Moon is in Aquarius when these notes begin, but leaves it for Pisces at 8 o'clock to-morrow morning. Just passing in and out of the extreme N.W. corner of Cetus, she moves into Aries at 4 a.m. on the 13th. Across this she travels until 10 a.m. on the 14th, when she enters Taurus. Travelling through Taurus, she arrives at 8 p.m. on the 16th on the confines of the northern strip of Orion. It takes her until 7 o'clock the next morning to cross this, and at that hour she emerges in Gemini. On the 18th, at 8h. 30m. p.m., she quits Gemini for Cancer; which she leaves, in turn, for Leo at 8 a.m. on the 20th. She is travelling through Leo until 1 p.m. on the 21st, when she descends into Sextans, re-entering Leo at 11 o'clock the same night. She finally quits Leo and enters Virgo at noon on the 22nd, and we there leave her.

Experiments are being made by the Government with a new locomotive torpedo steered by electricity from the shore. Very good results are said to have been obtained.

The anthracite coal trade in the United States has been in a far more prosperous condition just lately. Orders are plentiful, and the number is increasing.

"Let Knowledge grow from more to more."—Alfred Tennyson.

Only a small proportion of Letters received can possibly be inserted. Correspondents must not be offended, therefore, should their letters not appear.

All Editorial communications should be addressed to the Editor of Knowledge; *all Business communications to the* Publishers, *at the Office, 74, Great Queen-street, W.C.* If this is not attended to delays arise for which the Editor is not responsible.

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WAVE MEASUREMENT.

[At the special request of "Excelsior"—but also because the subject of his letter is one of great intrinsic interest—his letter is given in full, though in reality his reasoning is based on a misconception, and therefore falls to the ground.—R.P.]

[1696]—I have just been giving myself the pleasure of reading your valuable book, "The Sun," and should have regarded it with unmitigated satisfaction but that I find one argument in it which I cannot reconcile with facts, so shall be glad if you will kindly bear with me while I point out its inaccuracies. I refer to the foot-note on page 148, which treats of the breadth of water-waves on a canal as an example of the action of light-waves. As you may, perhaps, not have a copy of the book by you to refer to, I will, with your indulgence, quote in full the paragraph to which I take objection, and it is this:—"Let the reader imagine himself on the bank of a canal observing a series of waves uniformly propagated along the stream. . . . . Let the observer, fixing his eye on a certain wave, walk any measured distance (say 100 yards) at the same rate as the wave is moving. Suppose he accomplishes this distance in 65 secs. He knows then that the velocity of transmission of the waves is 100 yards in 65 secs. Let him now, standing still for 65 secs., count the number of crests that pass him in that time. Suppose 360 pass him, then, from his first observation, he knows that the first which passed him has travelled 100 yards from him. Within that distance all the 360 waves are uniformly distributed. Thus the breadth of each is 1-360th part of 100 yards, or 10 in. This result is perfectly reliable if, during his second observation, his position on the bank has been unchanged. But let us imagine that he has made his observations from a truck—on rails by the canal's edge—and that, unnoticed by him, the truck has glided uniformly along the rails. First suppose that this motion has taken place in a direction contrary to that of the waves, and that, while he is counting the passing crests, the truck glides a distance of 20 yards. It is evident that when the last wave passes him the first is 120 yards, instead of 100 yards, from him. Thus the 360 waves are distributed over 120 yards, and the true breadth of each is 1-360th part of 120 yards, or 12 in. If, on the other hand, the truck had moved over 20 yards in the same direction as the waves, it is equally obvious that the 360 waves would be distributed over only 80 yards, and the breadth of each would be only 8 in. Similarly, at whatever rate the truck moves it is evident that the observer can no longer depend on the result of his observations. If it moves in a direction *opposite* to that in which the waves travel, they appear *narrower* [? broader by foregoing example]; if it travel *with them* they appear *broader* [? narrower by foregoing example] than they really are. Indeed, it is not difficult to conceive the truck to move in the same direction and at the same rate as the waves travel, in which case (if we could suppose the observer to remain unconscious of that motion) all undulation would appear to him to have ceased, and the water to have a waved but unmoving surface." That is the paragraph; and now I will show, in as few words as are consistent with clearness, that it is inaccurate, to say the least of it. Well, in the first place, I will just briefly repeat your first illustration, which supposes an observer standing at a given point (hereafter referred to by me as the "starting-point") on a canal bank, and counting the waves as they pass him

for 65 secs., by which time the first wave has reached a point 100 yards distant from him, and a total of 360 waves have passed him, thus giving a distribution of 360 waves within the 100 yards, which shows each wave to be 1-306th part of 100 yards, or 10 in. in breadth. This is quite right. But suppose the observer, during the 65 secs., instead of standing still, to be unconsciously carried a distance of 20 yards, say, in the same direction as the waves are travelling, and supposing the waves to be travelling at exactly the same speed as in the first observation, then the first wave, at the expiration of the 65 secs., will have reached the 100 yards distance from the starting-point, and obviously the 360th wave will have just passed the starting-post as before; but not passed the observer this time, because he has travelled 20 yards away from the starting-point in the same direction as the waves, and, as this is one-fifth of the 100 yards, it is clear that only four-fifths, or 288, of the 360 waves can possibly have passed the observer, and these 288 will be all the waves that will be distributed over the remaining four-fifths, or 80 yards of the distance, thus showing each wave to be 1-288th part of 80 yards, or 10 in. in breadth, just the same breadth as shown by the first observation, and not 8 in., as you make it when your observer is travelling in the same direction as the waves. Then, again, suppose the observer during the 65 secs., instead of standing still, to be unconsciously carried 20 yards from the starting-point in a direction opposite to that of the waves' motion; and supposing again that the waves are travelling at exactly the same speed as before, then at the expiration of the 65 secs. the first wave will have reached the 100 yards distance from the starting-point, and obviously the 360th wave will again have just passed the starting-point and also passed the observer as well this time, but clearly, in addition to these 360, 72 other waves must also have passed him, because he has travelled 20 yards, which is equal to one-fifth of the original distance, farther back than the starting-point, and so an extra number of waves, equal to one-fifth of the original number, must also have passed him, thus giving a total of 432 waves distributed over the total distance of 120 yards now in question, which shows each wave to be 1-432nd part of 120 yards, or 10 in. in breadth, just the same breadth as shown by my first and second observations, and not 12 in. as you make it when your observer is travelling in the opposite direction to the waves. Thus, it is clear that the fact of the observer moving in either direction, at the time of making the observations, does not alter the breadth of the waves in the slightest degree, neither does it alter the speed at which the waves are actually travelling along the surface of the water, but it does alter the speed at which they pass the observer, or, in other words, the number which pass him in a given time; for in the first observation, when he stood still, 360 waves passed him in the 65 secs., while in my second example, when the observer was moving twenty yards in the same direction as the waves, only 288 passed him in the 65 secs., and in my third example, when moving twenty yards in the opposite direction, 432 passed him in the same time. And so with light waves. Supposing a star to be sending us light waves of a certain breadth, the fact of us approaching that star, and so travelling in an opposite direction to the light waves, will not make the waves broader, as your example, quoted herewith, would show; but will simply cause us to receive them more quickly than if we were standing still; and similarly our recession from the star, and so travelling in the same direction as the light waves will not make the waves narrower, as your example would show, but will simply cause us to receive them less quickly, according to the speed at which we are moving. Just as when you see a highwayman in the road coming towards you, if you stand still he will reach your pockets in a certain time; but if you move towards him (a very unlikely thing, I suppose) he will reach them much more quickly, and, on the other hand, if you run away from him he will get at them much less quickly, according to the speed at which you run away; and so you do not, by your movements, alter the size of the highwayman at all, but you do alter the speed at which he reaches you. And so, whatever change there may be in the spectrum of a star, according as we are approaching or receding from it, I do not see that it can be caused by any narrowing or widening of the wave lengths (or breadths) of its light, but by the greater or less speed at which the waves enter the spectroscope, according as we are approaching or receding from the star.

Even supposing your examples in the paragraph in question to be correct, the paragraph contains a blank contradiction of the examples, for in your examples you show, in the first place, that when the observer is standing still counting the passing waves the result gives to each wave a breadth of 10 inches; then, when he moves in the *opposite direction* to the waves, you get a result showing them to be 12 inches broad, which is 2 inches *broader*, and when he moves in the *same direction as the waves*, you get the breadth 8 inches, which is 2 inches *narrower*, and yet, near the bottom of the paragraph, is this sentence, "If it (the truck with observer) moves in a direction *opposite* to that in which the waves travel, they appear *narrower (sic)*; if it travel with them, they appear *broader* than they really are." You would, no doubt, notice that I indicated these mistakes by a query (?) and correction within parentheses in the places where they occur in the paragraph as quoted in full at commencement of this letter. How you managed to overlook such a contradiction so far as to allow it to be printed both in the *Cornhill* for 1863 and in "The Sun," I am at a loss to understand, and can only account for it on this theory, that the statements in the latter sentence of your paragraph, quoted above, are nearer the truth than your examples themselves, because, when an observer is moving in an opposite direction to the waves, a greater number of them pass him in any given time than when standing still, and thus at first sight they appear narrower, as stated in the sentence (and not 2 in. broader, as your example shows), though not narrower in reality, as I have proved by my example. And similarly, when moving in the same direction as the waves, a less number pass him in any given time that when standing still, and so they appear broader, as stated in the sentence (and not 2 in. narrower, as your example shows), though they are not broader in reality, as I have proved by my example. Therefore, it is clearly the results you obtain from your moving observer which are wrong.

Now I have tried my best to make myself plain, and hope I have succeeded, and that you will receive this letter in the spirit in which it is written—that of pure good will—for I greatly admire your wonderful talents both as a lecturer and writer, and it is only a sense of grief at finding such a mistake in the book in question which impels me to write this letter.—With every good wish, I beg to subscribe myself as usual,

EXCELSIOR.

[I am altogether grateful to "Excelsior" for the care with which he has explained my supposed mistake in the passage he has quoted; and although he is mistaken, as I shall show, in attributing error to me in this place, yet it is clear that, as he has failed in catching my meaning, I failed in my purpose, which was to make my meaning clear. The article from which he quotes, written in 1863 for the *Cornhill Magazine*, was the first matter I ever wrote for publication. Possibly this may account for its being not so clear (it would seem) as I meant to make it if I could. It was, however, written with great care; I should hardly expect to be believed if I were to tell how long I was at work upon it; and I had thought better of it than I fear I must now do—regarding it simply as a piece of explanatory writing. I can only say, with "Excelsior," that I had tried my best to make myself plain, and hoped I had succeeded.

In the first place, I must admit that I cannot see anything in the passage suggesting that I supposed, or wanted my readers to suppose, that the breadth of waves in a canal would be altered by the movements of a truck on the canal bank. It may have been, possibly, the conviction that no one would imagine me to mean *this* (in whatever other way I might fail to make my meaning clear) which prevented me from definitely saying that the waves would not really be altered, let the observer career as he might along the side of the canal.

Perhaps the following abstract of my reasoning in the quoted passage will set "Excelsior's" misgivings at rest:—

The real breadth of the waves is supposed to be unknown to the observer; only the details of the observation, as recorded, are available for forming an opinion. I point out, then, in my explanation, that

1. If the observer is, as he supposes, at rest, the real breadth of each wave is 10 in.

2. If he is moving unconsciously in a direction contrary to that of the waves at the stated rate, their real breadth is not 10 in., as he mistakenly infers, but 12 in.; in other words, he supposes them to be narrower than they really are—10 in., his estimate, being less than 12 in., the real breadth.

3. If he is moving, unconsciously, in the same direction as the waves, at the stated rate, their real breadth is not 10 in., as he mistakenly infers, but 8 in.; in other words, he supposes them to be broader than they really are—10 in., his estimate, being greater than 8 in., the real breadth.

The measurement of the breadth of canal waves is not a matter of much interest; but the matter illustrated by this supposed experiment is exceedingly interesting. When we are approaching or receding from a source of sound waves, the breadth of the waves is not altered, but our appreciation of their breadth is altered, in other words the tone is changed—made higher if we are approaching, lower if we are receding. For, observe, the tone we hear is not the breadth of the waves, but indicates our appreciation of their breadth. So with light. If we are receding from or approaching a source of light, we form a wrong estimate of the light's

colour—provided that our rate of approach bears an appreciable ratio to the enormous velocity of light. The change of colour is towards the red end of the colour-gamut if we are receding, towards the violet end if we are approaching. Hence has been derived the now celebrated method of determining rates of approach and recession of stars, star hurricanes, &c., viz., by displacement of some known line of the spectrum—a method in which I take much interest, seeing that I published a full, clear, and particular account of the method a considerable time before it was known that any attempt had been made to apply the method, or even that the method had occurred to any one. Some months after my article on the subject (in *Fraser's Magazine*) Father Secchi and Dr. Huggins severally announced the successful application of the method, and earlier than that, in fact immediately after my article appeared, Dr. Huggins informed me privately that he had been planning to apply the very method I had described. But, if any value attaches to the first public description of a method of research, afterwards applied successfully, I believe I can claim so much as that in this instance. Doppler's idea, of course, was valueless, as I pointed out; because in the case of a body like a star emitting rays of all the colours of the rainbow—besides invisible rays both on the violet and the red side of the spectrum—there would be no apparent change of colour, let the motion of approach or recession be ever so rapid.—R. P.]

THE RUDDY ECLIPSED MOON.

[1697]—I am pleased to see that Mr. Proctor has discussed one of my small astronomical heresies (Knowledge, p. 339), although he has handled it rather roughly. However we may differ in our conclusions, we are perfectly agreed in our object—the elucidation of truth. A man who has only one original idea, one dearly-beloved theory, usually regards everybody who disputes it as a personal enemy, and defends it savagely as a matter of personal honour. As neither Mr. Proctor nor myself are thus limited, we can mutually afford to discuss any one or another of our speculations or conclusions without personal offence, and to speak quite plainly in doing so. In this case we are widely at variance. I am as fully satisfied that he is wrong, as he is evidently convinced of my error.

In the first place, Mr. Proctor says that "Professor Langley's refined experiments with his delicate heat measurers (the 'bolometer,' I presume,) indicate for the moon's surface, even when she is full or exposed to the full blaze of sunlight, a temperature many degrees below the freezing-point." If the bolometer tells such a story as this, I can only reply, "So much the worse for the bolometer." There must either be "something wrong with the sun," or something wrong with the moon, or something wrong with the bolometer, unless we assume that the laws of thermal radiation, as observed on the earth, do not prevail at the moderate lunar distance beyond it.

It has been proved, not by one experiment, nor one heat measurer, but by every experiment ever made, intentionally or inevitably, that a solid body "exposed to the full blaze of sunlight" is heated greatly beyond the freezing-point, and to believe any heat measurer, however delicate, that told such a tale as Mr. Proctor recounts is comparable to the faith of a member of the Soudan expedition who, having a newly-invented thermometer that registered many degrees below freezing when exposed to the full blaze of the summer sun at Suakim, should believe that thermometer in preference to the evidence of his own senses.

There is one possible condition of a solid body, situated like the moon, receiving the full blaze of solar radiation without becoming correspondingly heated—viz., that it be a perfect reflector. If the moon were a ball of burnished silver it would reflect 90 per cent. of the solar rays, and the remaining 10 per cent. of solar energy would operate in raising its temperature above that of space; but then the moon would be more dazzling to our vision than the bit of looking-glass by means of which the naughty boy on the sunny side of the street prevents the good old gentleman from reading his newspaper at the opposite window.

Mr. Proctor next proceeds to tell us that the ruddy glow is produced by the transmission of "the sun's very own rays," and to state the amount of those which reach the moon by means of atmospheric refraction. We are agreed concerning the maximum thirty-five minutes of arc of entering refraction, and the additional thirty-five minutes of emerging refraction, making 1° 10′ altogether at sea-level; but when he assumes that these rays, thus diverted from their original course, will proceed to the moon as though they came in approximately parallel course from the sun, I go with him no further.

I maintain that after such refraction they become converging rays proceeding to *several foci* in space beyond the earth, then crossing and diverging. If the sun were a point of light and our atmosphere of uniform sea-level density throughout and achromatic, these rays would form one cone and have one focus corresponding in position to the apex of an isosceles triangle with base = earth's diameter, and interior angles at base = 88° 50′ (taking Mr. Proctor's figures, or 88° 38′ 14″, taking Sir John Herschel's).

But the sun not being a luminous point, and our atmosphere not being uniform, nor corrected like an achromaticlens, there must be a multitude of such cones and a corresponding distribution of foci. The limits of the space in which these foci occur are clearly worked out in Sir John Herschel's "Outlines of Astronomy," to which I originally referred as an exposition of the "usually-accepted theory," and which Mr. Proctor says I "evidently misunderstand." Whether it is I or Mr. Proctor who misunderstands, is indicated by the fact that his estimate of the result is profoundly at variance with that of Sir John Herschel, while mine is in perfect harmony with it. Sir John Herschel concludes his demonstration of the paths of the refracted rays by saying "it is evident that the totality of light thus thrown into the shadow, is to that which the earth intercepts, as the area of a circular section of the atmosphere to that of a diametrical section of the earth itself, and therefore, at all events, but feeble."

I said the same, my words being, "representing the earth by a globe of one foot in diameter, it (the ring of light) would be shown in proportion by a line of light $\frac{1}{4000}$ of a foot, or $\frac{1}{333}$ of an inch, about the thickness of the paper on which this is printed." Mr. Proctor's conclusions are extravagantly at variance with these.

He says that "if the sun were a bright point just beyond the earth's centre, as looked at from the moon," he would be seen as a ring all round the earth. I (following the demonstration of Sir John Herschel) maintain that in such a case he would not be seen there at all, as the focus of the rays from this point would fall between the earth and the moon, as shown in Sir John Herschel's diagram, and beyond this they would diverge and overshoot altogether that "single point on the earthward lunar face" which is Mr. Proctor's lunar standpoint.

According to Mr. Proctor's reasoning and diagrams, an eclipse of the moon by the earth's shadow cannot occur at all. He shows that the *whole* of the sun is uplifted into view from the lunar standpoint; that the sun is wholly and fully shining upon the moon without being hidden at all by the solid body of the earth. He thus presents us with a complete *reductio ad absurdum* of his own argument, for if such were the case the only eclipse the moon could suffer would be due to the shadow of our atmosphere. If the whole of the sun, as seen from the moon, were optically transferred from behind the earth to its circumference, and there spread out as a ring in the manner stated, and so plainly shown in Mr. Proctor's diagrams, the shadow of the earth, instead of being thrown upon the moon, would be simply projected towards its own centre. The effect on the moon would be simply to display an alteration of the shape of the sun—a conversion of the solar disc into a solar ring, radiating the same amount of light as the disc, minus only that obstructed by our atmosphere. All his diagrams and reasoning show this, even the details of the distorted spots.

In his calculation of the amount of light thus displayed, he falls into a fallacy which surprises me, seeing that it is purely mathematical. The figures on the second column of page 341 affirm that the amount of sunlight transmitted by the annular whole sun (assuming that one-half is absorbed in passage) is $\frac{1}{11\frac{1}{2}\frac{1}{5}}$ of the ordinary sunlight. This conclusion is reached by comparing the comparative area of the annular or distorted sun to that of the solar disc; but Mr. Proctor surely understands that if the *whole sun* is represented by that ring in the manner he describes, the intensity of the luminosity of the ring, as compared with that of the solar disc, will vary inversely with the apparent area of the ring as compared with the apparent area of the disc; or, otherwise stated, the total luminosity of the ring will be equal to the total luminosity of disc (viewed under like circumstances) whatever be their comparative areas. Therefore, with such a ring displaying the *whole* sun to the moon in the manner stated, the eclipsed moon would only differ from the full moon by the loss of light due to atmospheric obstruction.

This reply has extended so far that I must not describe in detail the observation I made on the eclipse of the moon October 4 last, when the "poor thing" did not show any ruddy glow at all, but only a faint, dirty grey illumination, totally different from that of the eclipse of August 23, 1877, which I observed during my walk from Castlebar to Ballina. I may, however, mention that in 1877 the glow was uniform over the whole face of the moon, and gradually faded during the totality, as it should do if the moon itself were cooling down by radiation, while the grey twilight of 1884 was one-sided at first, then nearly disappeared when the moon was in the centre of the shadow, and reappeared on the opposite side as the moon approached the opposite limit of the shadow. This is exactly what should occur according to Sir John Herschel's

demonstration, while the behaviour of the ruddy glow was directly contradictory to it.

I therefore await another opportunity of further observation in order to confirm or refute my present supposition, viz., that both sources of illumination operate and are superposed, but the ruddy, copper-like glow is only seen when and where the atmosphere is permeable by obscure heat rays. W. MATTIEU WILLIAMS.

EFFECT OF COLOUR UPON TEMPERAMENT.

[1698]—The *Sanitary Record* states that puppies have been brought up under coloured glass, with the result that under red pugnacity was deficient; under blue temper was bad; but under green the subjects were lively, cheerful, graceful, playful, and good-tempered. The *Pall Mall Gazette* remarks that these differences are "in nowise such as the association of ideas would lead us to expect." This is a mistake; red is the coolest, blue the hottest (save indigo and violet), and the nervous irritability would be in proportion. Green being the *juste milieu*, might be expected to give the best results. There may be sense in the advice to have all nurseries glazed green. HALLYARDS.

THE EVOLUTION OF THE SENSE OF BEAUTY.

[1699]—May I be permitted to correct an error in the instalment of my article which appeared in your issue of April 24th? I refer to the following sentence:—"Sir John Lubbock finds that they [bees] chiefly affect orange and yellow, and that they like blue next best." This statement was made in my rough draft, when I was acquainted with only the earlier experiments of this distinguished observer, described in the "Journal of the Linnæan Society," vol. xiii. (Zoology). The alteration which I afterwards inserted—"Sir John Lubbock finds that they show a decided preference for blue"—was unfortunately omitted in transcription; and, as I did not receive proofs, I was not able to make the correction. I may mention also the misprint of "Englena" for "Euglena," and "eclimi" for "echini."

CONSTANCE C. W. NADEN.

[1700]—In an article under the above heading in last week's KNOWLEDGE, the writer states that "the first animal which *developed* a dim colour perception would from the outset find pleasure in exercising the new faculty." Will she kindly explain how this development came about? Is not this precisely what she proposes to ascertain? and yet the subsequent reasoning is based on this statement. G. H.

MATTER REQUIRING REFLECTION.

[1701]—Berkeley's theory of the non-existence of the universe, except in some mind or minds, is puzzling.

Here is another puzzle. In the room in which I am writing there is a looking-glass over the mantelpiece, and on the mantelpiece a clock. Now if I stand directly opposite the clock I see no reflection of it in the glass, its image being hidden (so it is difficult to help believing) by the clock itself. But if I move to the right I see the reflection to the right of the clock; if I move to the left I see it on the left. The farther I move to the right or left the nearer to the right or left edge of the glass moves the reflection. If I stand in one position, and some one else in another, I see the reflection on one part of the glass, he on a different part.

Now suppose we both quit the room, leaving it empty of mind and eyes, on which portion of the glass is the clock reflected, or is it reflected at all in the absence of eyes to see the reflection?

M. T. H.

"FULL INSIDE."

[1702]—"C. N." (1681) admits that something exists independently of consciousness, which something, I assert, must by invincible necessity be external. And if external, then by the interactions of this something and my reasoning faculty through the media of sensations I am approximately made acquainted with the mutual relativity that subsists between me, the subject, and it, the object. I know, therefore, that this something, whilst internally conceived, externally exists. It exists externally to me. If it were not so, then could mind have no conception of it, since sensation would be wanting, or, having conception, could have no basis of certitude for the truth of its ideas. J. S.

LETTERS RECEIVED AND SHORT ANSWERS.

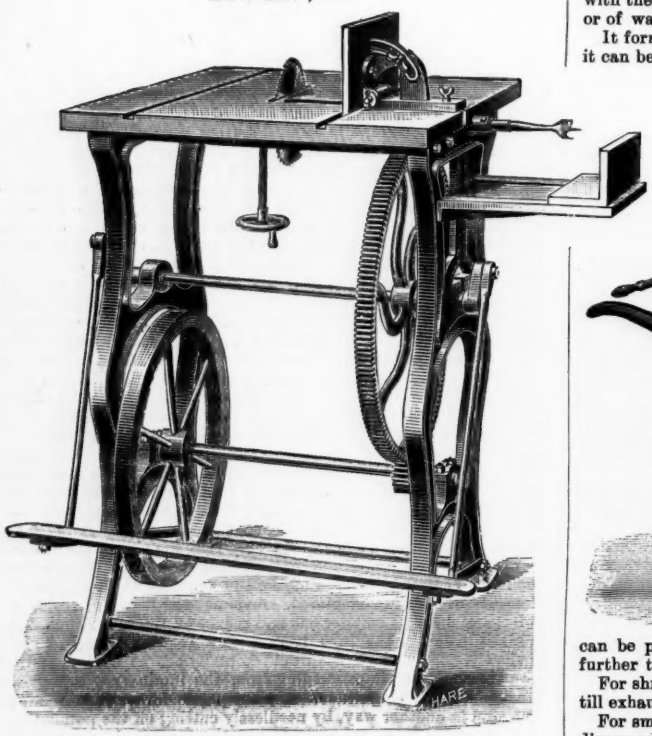
BERNARD THOMAS.—The centre of the circle, whereof any given Rainbow forms an arc, is always situated 180° from the Sun's place in the celestial vault. Now, when the sun was 2h. 45m. past the meridian at Llandudno on April 25 he must have been a very little over 38° 29′ above the horizon; and hence the centre of your rainbow arc must have been depressed by that amount below the opposite point of it. But the radius of a rainbow is about 41°, hence the little piece only which you saw peeping above the horizon. Of course, as the Sun's altitude declined, the Rainbow would rise. —HAROLD TAYLOR suggests that the concluding sentence in the paper on the Ruddy Eclipsed Moon (p. 342, col. I.) is not quite intelligible.—THETA. The sphere is supposed to be divided into twelve equal spherical pentagons, two of them polar; and an equidistant projection of each of the twelve overlapping spherical spaces enclosed by the circles circumscribing these pentagons is given.—PATEX-ATOM(?). See Vol. V. of KNOWLEDGE, pp. 180 *et seq.*, for reply to your first question. With regard to your second,—When it is New Moon to the Earth it is Full Earth to the Moon. The so-called "Old Moon is the New Moon's arms," is simply the part of the lunar disc upon which the sun has not yet risen, lit up by earth-shine. It is what is called "Irradiation," which makes the sun-lit crescent of the moon seem bigger that than part visible only by the comparatively dim earth-light.—EAST WIND. I have asked for information myself (*vide* p. 353).—G. H. Knox's "Differential Calculus for Beginners," published by MacMillan & Co., and reviewed on p. 56, is first-rate. See, too, the "Easy Lessons," by the conductor of this journal in our second volume. I know of nothing equally simple treating of the Integral Calculus.—SENEX. Well, if you need a more striking illustration, take an ephemeron and a raven born on the same day.—A WORKING MAN asks Mr. Mattieu Williams exactly how much bicarbonate of potash should be added to, say, a quart of gooseberries to exactly neutralise their acidity. He has been experimenting recently with the result that the fruit "always effervesces with the acid . . . . and gives it a funny taste." He also finds maltose "answer very well indeed with bread, but not so well with oatmeal;" but is not sure whether he has the right kind of malt. The first he obtained was called pale malt, but he afterwards got some "exactly like ground coffee." He wishes to know which is the proper kind to use.—C. ARTHUR PEARSON. An oak, boxwood, or lignum vitæ ball of an inch in diameter would fall from the top of a tower 200 feet high in *precisely* the same time as a leaden one of the same dimensions. A feather ball of the same size would also fall in the same time, but for the resistance offered by the air. In vacuo, a feather and a piece of platinum would reach the ground at the same identical instant. See paragraph in capital letters concluding those which head the Correspondence Column.—W. D. JOHNSTON. If gas existed in space it must retard the passage of bodies through it. Try to run when chest-high in water. Start on the engine of an express-train on a calm day and travel at the rate of sixty miles an hour, and feel the resistance of the air; and then consider cosmical velocities, and see how infallibly the gaseous contents of space which you postulate must derange the motion of everything traversing it.—A SUBSCRIBER. I don't know. It is a question having no reference to science.—A CONSTANT READER OF KNOWLEDGE asks for Mr. Browning's advice anent a tricycle which he wishes to ride with his wife. He is already a bicyclist; and the lady wishes to get a machine which she can either ride alone or with him. Is a Sociable or a Tandem the best for all-round work? If so, what description of either sort?—W. W. Vol. II. of the "Celestial Cycle," by the late Admiral Smyth (the "Bedford Catalogue"). Fomalhaut is simply fom-al-hút—the Arabic for "the fish's mouth," the star being situated in the jaws of Piscis Austalis. Betelgeux, Smyth derives from the Arabic ibt-al-jauzà—the giant's arm-pit, or shoulder—*a* Orionis being situated in that part of the conventional figure of the great hunter.—RAPHAEL TUCK & SONS, C. NOTTAGE. Received with thanks.—R. E. C. Without troubling "F.R.A.S." in the matter at all, it will suffice to say here that the size of the flat in a Newtonian telescope should be sufficient to reflect all the rays coming to it from the image of the sun or moon at that portion of the cone in which it is placed. Obviously the image of a star is a point, and hence a smaller flat will reflect all the rays which reach a given point in the tube from such a source; though, equally obviously, such a small flat would actually act as a stop, and cut off part of the light proceeding from the luminary with a disc of sensible angular magnitude. A plane made larger than this acts as a stop in another way, by needlessly cutting off the parallel rays *en route* to the large mirror. Hence the reason why, in practice, the diagonal reflector slightly exceeds the size merely needful to send on all the rays from a fixed star. Your idea of bevelling its edge is theoretically good, but would, of course, add to its cost.—W. B. You are too funny—you are, really.—A. NEILSON. Glad to

have been of some service; but really the common sense of the theory seems obvious. Jones and you may have as much abstract right to hire a hansom as Smith and myself, but if we enter it first, "precedence *does* imply exclusion."—I. S. asks if any reader will inform him how to kill Amphibia quickly for purposes of dissection?—C. M. Harbord. My dear young friend,—Neither I nor any other human being can tell you "how many birds there are now existing in the world!" I might just as well ask you to give me an approximate estimate of the number of fish in the sea. —Fred. Lobnitz asks for a general formula, to give the curvature which a wire should have when supported by its two ends from points of different heights, in order that it may be exposed to the minimum of stress from its own weight.—Hallyards. Yes, he is. No doubt things have appeared, as you say, touching it a little more nearly, but if you were in my place, and could see the reams of violent and irrelevant correspondence which its admission entails, you would rather wonder that it has not been stopped before than that it has been permitted to go on so long. *Vires acquirit eundo.*

Our Inventors' Column.

We give here, week by week, a terse description of such of the many inventions as we think may be of use to our readers. Where it is possible, the number of the patent is quoted, to enable those who desire fuller information to procure the specification from the Patent Office in Cursitor-street, Chancery-lane. We shall, generally speaking, confine ourselves to the more recent inventions; but it often happens that an article comes under our notice which, although not quite novel, is worthy of mention for its utility and ingenuity. In such a case we should not hesitate to refer our readers to it. And while we thus increase the interest of our pages, we at the same time assist the inventors by giving greater publicity to their inventions (Knowledge *being a popular magazine*) *than is accorded by the most excellent trade journals.*

NEW SAW, &c.



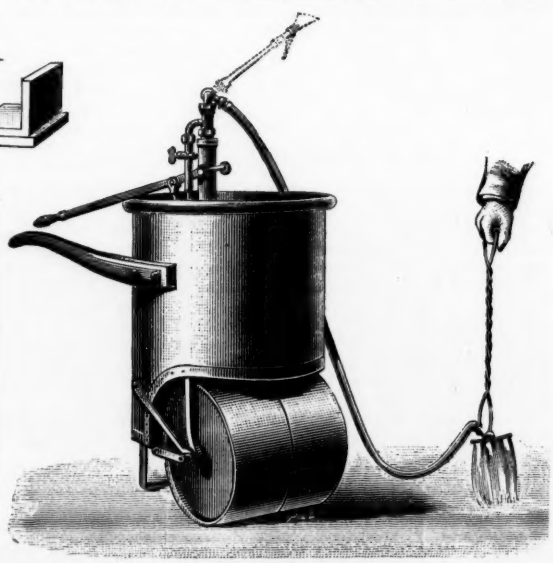
[Patented in 1885.]—This tool, introduced by the Britannia Company, of Colchester, is adapted to the requirements of the majority of wood-workers. The substitution of cog-wheels for the ordinary band-saw is an advantage, in so far as it prevents slipping, while the heavy fly-wheel may often prove of service. It will be seen that the machine is worked by fast power, but a means for applying hand-power as an auxiliary or in lieu of foot-power is provided on the left side. The saw will cut up to 4 in. square, and it is stated, when worked by foot, 3 ft. 8 in. of 1-in. mahogany can be cut after the foot is taken off the treadle. Fret-cutting may be done by a separate appliance, the upper arm being suspended from the wall or ceiling, and only let down when wanted, thus leaving the table clear for work of any size. Grooving can be rapidly executed by a thick saw, and dowelling is done on the adjustable table which is shown at the side of the machine, a special appliance being fitted for holding the work and ensuring uniformity. The machine is also adaptable for mitre-cutting, common gilt moulding for picture-frames being cut clean and without any shake. Holes up to 2 in. in diameter can be bored with great rapidity.

GARDEN-ENGINE.

[Patented 1884.]—Mr. E. Newton, of Hitchin, has patented a hose-reel and garden-engine, the former of which, in place of wheels which do much harm to paths, &c., is provided with rollers moving more easily, and doing good each time they pass on the path in rolling it more solid. A lawn can be crossed without fear of making ruts, while in turning, a stationary roller is provided which does not cut in, like a wheel. The shape of the tub of the engine is such that when the handles are raised for driving, the water does not flow over the front (at top), but lightens the weight from handles as it goes forward.

The syphon arrangement is easily started by adding the hose-piece, which, for watering carpet bedding, and beds of all kinds, gives about the same force of water as from a can, doing away with the general complaint of splashing the mould on to the plants or of washing away the mould from the top roots of plants.

It forms a useful machine when water is required temperate, as it can be filled, and when anything feeding for plants is required



can be put in and drawn off to each plant as required, without further trouble.

For shrubs, &c., the hose can be lengthened, and the water flows till exhausted.

For small gardens the necessity for an ordinary garden roller is dispensed with.

The winter wheat acreage in the United States has been reduced by 3,000,000 acres, the condition of the crop being 77 as against 96 of last April.

Our Mathematical Column.

MATHEMATICS OF METEORIC ASTRONOMY.

By RICHARD A. PROCTOR.

(*Continued from p.* 336.)

IT will be well next to consider the case of a planet regarded at first as acting alone on a meteor. Of course no meteoric body can ever be drawn towards a planet under the influence of the planet's attraction solely, since each such body entering our solar system is under the chief attraction of the sun, whose mass exceeds the combined mass of all the rest of the system nearly 730 times, and the mass of Jupiter the largest planet 1,048 times. Still we shall find the advantage of inquiring what velocities Jupiter and other planets could severally impart to meteoric bodies approaching them under their sole attraction.

Let us begin with the earth herself. In her case we know the actual force we have to deal with from direct evidence. We know that the earth's mass acting on bodies at her surface, 3,960 miles from the centre (where all the mass may, as Newton long since showed, be supposed to be gathered) imparts in one second a velocity of 32·2 feet per second. It will be well, however, to use the mile as the unit of length, in which case terrestrial gravity at the earth's surface is represented by 32·2 ÷ 5,280, and the constant μ for this case, since it represents the force at a distance of one mile, is given by the equation

$$\mu = \frac{32{\cdot}2}{5280} \times (3960)^2$$
$$= \frac{322}{44} \times 33 \times 396 = 322 \times 3 \times 99$$
$$= 95{,}634.$$

[It will be noticed that this determination of μ for the earth is independent, while the determination of μ for the sun depended only on the determination of the sun's distance as 92,600,000 miles. Thus we may regard these two determinations as involving an independent measurement of the sun's mass, which

$$= \frac{\mu \text{ as determined for the sun}}{\mu \text{ as determined for the earth}} \cdot \text{earth's mass}$$
$$= \frac{31{,}298{,}800{,}000}{95{,}634}$$
$$= 327{,}300, \text{ calling the earth's mass unity.}]$$

To determine, then, the velocity of a body approaching the earth under her sole attraction from a very great distance, at any given distance x, we have

$$v^2 = \frac{2 \times 95{,}634}{x} = \frac{191268}{x}$$

Thus, if we require the velocity of such a body at the earth's surface we have

$$v^2 = \frac{191268}{3960} = 48{\cdot}3$$

$$v = 6{\cdot}95 \text{ approximately.}$$

Thus a body drawn from an infinite distance to the earth's surface under her attraction only, would reach her surface with a velocity of nearly 7 miles per second, and a body would have to be shot from the earth's surface with this velocity to pass away for ever from her, if she were the only orb in existence.

Again, at the moon's mean distance, 238,818 miles, we should have

$$v^2 = \frac{191268}{238818} = 0{\cdot}8009$$

and $$v = {\cdot}895$$

This is the velocity with which a body approaching the earth under her sole attraction from rest at an infinite distance would cross the moon's orbit. The moon's mean velocity, apart from the sun's influence, which slightly diminishes the earth's influence on her, would be

$$= {\cdot}895 \times \sqrt{2} = {\cdot}6328 \text{ (miles per second)}$$
$$= 2278{\cdot}08 \text{ miles per hour.}$$

But now, before leaving the earth, it may be interesting to inquire what are the velocities which the earth can *add* to velocities already imparted by the sun to bodies travelling up to the earth on their way towards him. In order to get the maximum effect which the earth may be supposed to impart in this way, and also to simplify the problem, I suppose the earth at rest, and the motion of the approaching body to take place in a straight line:—

Fig. 2.

Let then the body move along the straight line A P E S, Fig. 2, towards the earth at E and the sun at S. Put P S = x, E S = R (as before). Then, dealing with this problem as we dealt with the simpler case of the sun alone attracting, we get, writing μ for the solar constant μ^1 for the terrestrial constant of force, the equation

$$\frac{d^2x}{dt^2} = -\frac{\mu}{x^2} - \frac{\mu^1}{(x-R)^2};$$

And treating this as before, we get

$$\left(\frac{dx}{dt}\right)^2 = v^2 = \frac{2\mu}{x} + \frac{2\mu^1}{(x-R)} + C.$$

In the case of a body starting from rest at an infinite distance, we have C = 0. Wherefore, in this case

$$v^2 = \frac{2\mu}{x} + \frac{2\mu^1}{x-R}$$

Now put $(x-R)$ = radius of earth = 3960; and x = 92,600,000. Then, substituting for μ and μ^1 their values as already determined, we have, for v the velocity of the body as it reaches the earth's surface, the equation

$$v^2 = \frac{676 \times 92{,}600{,}000}{92{,}600{,}000} + \frac{191{,}268}{3960};$$
$$= 676 + 48{\cdot}3 = 724{\cdot}3;$$

and $$v = 26{\cdot}9$$

So that the increase of velocity, even in the case of a body which, having been drawn towards the sun from rest at a very great distance, comes eventually to the very surface of the earth, could not be more than 9-10ths (26·9 − 26) of a mile per second, even if the earth were airless and so the body came with unimpaired speed to the surface. In every case, then, the influence of the earth on bodies reaching her from outside with sun-imparted velocities must be comparatively insignificant—unless these bodies come upon her from behind (speaking with reference to her own motion), when, their relative velocities being diminished by her own velocity, may be reduced to 7¼ miles per second. In such cases terrestrial attraction might quite largely affect the apparent directions of meteoric motion. However, these cases are comparatively infrequent.

(*To be continued.*)

ANTHROPOLOGICAL INSTITUTE.—On April 28 (Francis Galton, Esq., F.R.S., President, in the chair) Mr. A. L. Lewis read a paper on the past and present condition of certain rude stone monuments in Westmoreland. A little to the south of the village of Shap are the remains of some very extensive rude stone monuments, to which allusion was made by Camden in the fifteenth century, and by Dr. Stukeley in the middle of the last century, and a circle is said to have been destroyed when the railway was made. The most interesting monument in this neighbourhood is situated at a place called Gunnerskeld, two or three miles to the north of the village, and consists of two irregular, concentric, slightly oval rings, about fifty and a hundred feet in diameter respectively, the longest diameters being from north to south. A paper by Admiral F. S. Tremlett on "Quadrilateral Constructions" near Carnac was read, which described certain enclosures explored by the late Mr. James Miln. In each case the boundary walls are formed of coarse undressed stones, put together without any kind of cement, and having built up in them a series of small menliers. They also contained beehive structures for cremation, reddened and become friable from the effects of great heat; it would appear that the cremation had been perfect, as not a particle of calcined bone was found in either of the enclosures. A paper by M. Jean L'Heureux, on the "Kekip-Sesoators, or Ancient Sacrificial Stone of the North-West Tribes of Canada," was read. The stone, which consists of a roughly hewn quartz, or boulder, about 15 in. high, and 14 in. in diameter, is placed on the summit of a pyramidal mound, commanding an extensive view of both the Red Deer and Bow River valleys. In cases of public or private calamity, or when a special blessing is sought, a solitary warrior, after keeping vigil on the top of the mount from sunset till the rising of the morning star, then lays a finger of his left hand on the top of the stone and cuts it off. Amongst the Blackfeet these self-inflicted wounds ranked equal to those received in battle, and are always mentioned first in the public recital of the warrior's great deeds.

Our Chess Column.

By Mephisto.

An offhand game played at Pursell's Chess Room some time ago:

Giuoco Piano.

White. P. J. L.	Black. C. H. B.
1. P to K4	P to K4
2. Kt to KB3	Kt to QB3
3. B to B4	B to B4
4. P to B3	P to Q3

Kt to B3 is a better move.

5. P to QKt4	B to Kt3
6. Q to Kt3	Q to B3
7. P to Q3	P to KR3
8. P to QR4	P to QR4

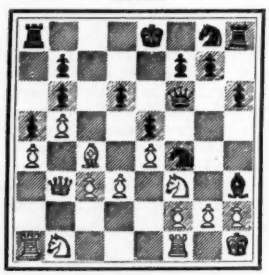
On the whole, White does not gain much by advancing the Pawns on the Queen's side early in the game.

9. P to Kt5	QKt to K2
10. B to K3	Kt to Kt3

Black allows the B to be taken, although it disconnects his Pawns. As a matter of judgment, it may be argued out this wise: Although the KtP and QP will be weakened after White plays B × B, yet there is no B to attack them. *Pro contra*, if Black plays B × B, White's centre will be strengthened. White's K's side is also weakened by the exchange. It allows the Kt to play to KB5, always a good position.

11. B × B	P × B
12. Castles	Kt to B5
13. K to R sq.	B to R6

Black.



White.

Certainly a bold move, which at the present moment hardly looks like paying. Now the weakness of White's move of Q to Kt3 is apparent, by the Q being out of play and the K's side weakened.

14. P × B	Kt × RP
15. QKt to Q2	Kt to K2
16. B to Q5	

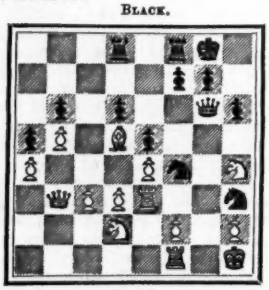
These, and the following moves on White's part constitute mere loss of time, he might have attempted to displace the Kt on R6 by playing Kt to Kt sq.

	Castles
17. B × P	QR to Q sq.
18. B to Q5	Kt to Kt3
19. QR to K sq.	Kt (Kt3) to B5
20. R to K3	Q to Kt3

Black has certainly made the most of his attack, and conducted the game with good judgment. White could only save the game temporarily by playing Kt to Kt5, followed by R to Kt3.

21. Kt to R4

Black.



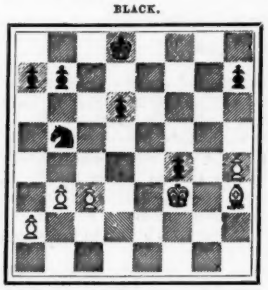
White.

Black mates in two moves.

USEFUL END GAMES.

The following ending occurred in a well-contested game played at Wakefield between Messrs. T. G. Stokoe (White) and H. Jackson (Black):—

Black.



White.

White played.	
35. P to B4	Kt to B6
36. K × P	K to K2
37. K to Kt5	K to B2
38. K to R6	K to Kt sq.
39. B to K6 (ch)	

Waste of time.

	K to R sq.
40. B to B5	Kt × P
41. B × P	Kt to B8
42. P to Kt4	Kt to R7
43. P to Kt5	Kt to Kt5

Kt to B6 is stronger, also P to R4; but in any case White could draw.

44. B to K4	P to Kt3
45. K to Kt6	Kt to R7
46. K to B6	Kt to B6
47. B to B6	Kt to R5
48. K to K7	Kt to B4
49. K × P	P to R3
50. P × P	Kt × P
51. K to Q7	

The position is rather singular. Black must try and exchange the Kt for the P, in order to draw. If White plays 51. B to Kt5, Kt to B5. 52. K to B6, Kt to Q6. 53. K × P, K to Kt2. 54. K to B7, K to R3. 55. K to Q6, K to R4. 56. B to Q8 (ch), K × P. 57. B to Kt6, with more chance of winning than as actually played.

	Kt to B4 (ch)
52. K to B7	Kt to Q6
53. K × P	Kt to K4
54. P to B5	Kt to Q6

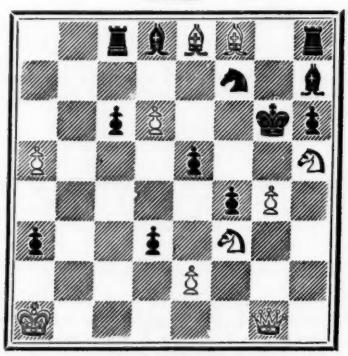
and by getting the P, Black draws.

PROBLEM No. 156.

Motto "Traumerei."

Chess Monthly Problem Competition.

Black.



White.

White to play and mate in three moves.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess Editor.*

Correct solutions received from H. A. N., W., W. Furnival, W. T. Hooton.

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